PROCEEDINGS

AND

COMMUNICATIONS

OF THE

ESSEX INSTITUTE.

VOLUME VI. PART II.

1868-71.

SALEM:
PUBLISHED BY THE ESSEX INSTITUTE.
MARCH, 1871.

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COMMUNICATIONS.

NOTICE.

With this volume of the PROCEEDINGS AND COMMUNICATIONS OF THE ESSEX INSTITUTE the publication is brought to a close.

The proceedings at the meetings of the Institute since the close of the year 1868 have been published in the monthly BULLETIN of the Institute, in which journal the communications made at the meetings have also been printed in full or by abstract.

The Bulletin of the Institute is a monthly sheet of about 16 pages and is distributed free to members, or mailed to any address on the receipt of the subscription of $1.00 per annum. — EDITOR.

PROCEEDINGS

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ESSEX INSTITUTE.

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ESSEX INSTITUTE PRESS.

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ESSEX INSTITUTE.

MONDAY, JANUARY 25, 1868. — Social Meeting at Hamilton Hall.
Vice President A. C. GOODELL in the chair.

AFTER some preliminary business, and remarks by the chairman, Rev. E. C. BOLLES of Portland was introduced and spoke of the microscopic structure of plants.

The address was an eloquent statement of the nature, form, growth and multiplication of vegetable cells; full of beautiful descriptions of the methods and operations, revealed only by the microscope, by which from their respective germs are evolved the forms alike of the stateliest trees of the forests and minutest mould or plant that microscopy has revealed.

JOHN D. PHILBRICK, of Boston, well known from his labors in behalf of popular education, made a few remarks on the value of Scientific knowledge to the school teacher, and the importance of the study of natural history in our system of instruction.

The meeting then adjourned, and the company was invited to examine the objects placed under the microscopes, illustrative of the remarks of the lecturer. A collation and social entertainment closed the programme for the evening.

Diagrams drawn with white and colored crayons upon the Blackboard, by Mr. E. S. MORSE, were used in illustration of the subject. On the walls were suspended several of the magnificient lithographs of Allen's Victoria Regia. Around the room were arranged thirty-six Microscopes under which were placed slides containing specimens of transverse and longitudinal sections of exogenous and endogenous plants; of leaves, cuticle, spores, pollen; and sections of coal and hard vegetable tissue; most of them were prepared by Mr. E. Bicknell.

LIST OF OBJECTS.

Exogens: — No. 1. Transverse section of Spruce (*Abies alba*), showing cells cut through; 2. Longitudinal section of the Spruce, radial, showing glandular dots, colored; 3. Longitudinal section of the Spruce, tangential, showing glandular dots cut through, colored; 4. Longitudinal section of California "Big Tree" (*Sequoia gigantea*); 5. Transverse section of Oak (*Quercus bicolor*); 6. Transverse section of Basswood (*Tilia Americana*), showing bast cells; 7. Longitudinal section of Basswood, showing spiral cells, colored; 8. Transverse section of Birch (*Betula alba*); 9. Transverse section of Blackberry (*Rubus villosus*), colored; 10. Transverse section of Clematis (*C. Virginiana*), colored; 11. Transverse section of Aristolochia (*A. sipho*), colored; 12. Transverse section of Evening Primrose (*Oenothera biennis*), showing dotted ducts.

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MONDAY, JANUARY 13, 1868. — Regular Meeting.

Vice President GOODELL in the chair.

Correspondence and donations announced.

Dr. G. B. LORING read an able and interesting communication on the life and character of Chief Justice Parsons.

Dr. Loring commenced by an allusion to the distinguished men of Essex County, and to what they have performed for the elevation of mankind and for the glory and honor of our common country; to Lieut. Gov. Phillips who founded the Theological Seminary at Andover; to Abbott and Stuart and Woods as theologians; to Story and Parsons and Prescott and Putnam and Saltonstall and Pickering and Rantoul as lawyers; to Jonathan Jackson and Peabody and Perkins and Pickman and Derby as merchants; to Prescott as a historian, Whittier as a poet, and Hawthorne as a novelist; to Bowditch as a mathematician. Of all these he selected Theophilus Parsons, as one of the most remarkable. He was born in Byfield, February 24th,

1750. His father was Rev. Moses Parsons, descended from a merchant who died in Gloucester in 1689. His mother was Susan Davis, descended from John Robinson of Leyden, the Puritan minister. The frugal life of the early New England clergy was described—the salary of Mr. Parsons being $280 a year, and requiring his labor on his farm and occasional sporting on the marshes to support his family. He was the general adviser of all matters secular and religious in his parish, when he was settled for life. Theophilus Parsons entered college at Cambridge in 1765; was graduated in 1769; taught school and studied and practiced law in Falmouth until 1775; returned on the burning of that town by the British, to Byfield; met at his father's house, Judge Trowbridge, who had fled from Cambridge for the safe enjoyment of his toryism, whom Chancellor Kent calls "the oracle of common law in New England," and whose library was invaluable to the young law student; and in a short time settled as a lawyer in Newburyport. Here he married Elizabeth Greenleaf, Jan. 13, 1780, built a house on Green street, lived there twenty years; removed to Boston in 1800, was appointed Chief Justice of Massachusetts in 1806, and died Oct. 30, 1813. Not a very eventful life in a very eventful period. While the great work of the revolution was going on he was a quiet lawyer in Newburyport. He had great love of his profession, and great powers which would have distinguished him in any sphere of life. While residing in Newburyport, in 1778, when he was twenty-eight years old, the question of a Constitution for Massachusetts was presented to the people. There was great popular jealousy against all law and all lawyers—Dr. Loring read a curious extract from a letter written by W. Symmes, jr., of Andover, to Isaac Osgood, Clerk of the Courts in Essex County, at that time, to show the difficulties under which lawyers labored in those days. While the question of the State Constitution was pending, young Parsons called a meeting of the citizens of Newburyport, March 27th, 1778, and issued a circular to the selectmen of the several towns in Essex County, to meet by delegates in a convention to meet in Ipswich in April of that year. Among the delegates appear the names of Theophilus Parsons, Tristram Dalton, Jonathan Greenleaf, Jonathan Jackson and Stephen Cross of Newburyport; of Ward, Goodhue. Andrews, Goodale and Sprague of Salem; Putnam and Shillaber of Danvers; Farley and Noyes of Ipswich; Coffin and Porter of Gloucester; Gould and Clarke of Topsfield; Dodge of Wenham; Perley of Boxford; and "the Hon. Caleb Cushing, Esq., of Salisbury." This convention sent forth the famous "Essex Result," a paper written by Parsons, and containing sound theories of government. "It was an earnest endeavor to discover and declare how progress and conservatism, liberty and order, might be adjusted in human institutions, that freedom should be secure, and peace and happiness be the children of freedom." Upon its suggestions was based the first Constitution of Massachusetts, carried as they were by the young lawyer of Newburyport, into the subsequent state convention, and submitted to the Bowdoins and Adamses, and Lowells, and Pickerings, and Strongs of that distinguished body.

After this Parsons retired from politics, was engaged in private practice for ten years, and did not emerge again until the Constitutional Convention of 1788. In this convention, when there was great danger of rejecting the Federal Constitution, he offered his well known "conciliatory resolution." That it might be explicity declared that "all powers not expressly delegated to Congress are reserved to

the several states, to be by them exercised." This is the first declaration of the doctrine of State Rights. It secured the adoption of the Constitution, and drew from John Adams the statement that "our Constitution was made for a moral and religious people; it is wholly inadequate to the government of any other."

Having accomplished this work, Parsons again retired to his profession, to receive the highest honors which the law can bestow. Under his administration as Chief Justice, the confusion and complication which had attended the forms of practice here, began at once to disappear; and to him more than any other may be attributed the reformed state of the dockets throughout the Commonwealth, the promptness of decisions, the regularity of trials, attesting the beneficial effects of a system which he did so much to render popular and permanent.

As a jurist he was undoubtedly among the great lawyers of this county and state. To a citizen of Essex County the name of Story will at once occur as a contestant for the highest judicial distinction among us. Story and Parsons, both learned in the law, both endowed with large intellect, both possessing a high moral tone — and yet how different! The one diffuse, impetuous, unconstrained — the other concise, systematic, condensed, exhausting. Parsons left the most law — Story the most books. Parsons cut his path directly to the object — Story led his followers through devious paths obstructed by difficulties of which he never lost sight. Parsons loved the sharpest analysis — Story delighted in an accumulation of all that related to his subject. Parsons was a great thinker — Story a great talker. Parsons gave his opinion to a jury — Story gave the argument. Parsons never forgot that he was a judge — Story never forgot that he was a lawyer. Parsons was an accurate mathematician, a careful student, a good scholar. Story's proper sphere was in the walks of his profession. The piercing, penetrating eye of Parsons was always directed upon the point aimed at — the eye of Story roamed through all space. Both had industry, both had humor, both had a kind humanity, both had deep faith. Both had a certain intellectual arrogance, the prevailing reproach of all great human powers, and both had that genuine kindness and private affection which attend all true greatness.

Mr. H. M. Brooks, after a few remarks, moved that the thanks of the Institute be presented to Dr. Loring for the paper read this evening and that a copy be requested for the archives.

N. K. Allen, B. H. Osgood and E. A. Smith of Salem; B. C. Perkins, A. M. Dudley of South Danvers; William Howland, of Lynn; W. W. Eaton, Edward Hutchinson, Augustus Mudge, Frederic W. Wentworth, George Farley, and George W. Andrews, of Danvers, were elected Resident Members.

MONDAY, JANUARY 20, 1868. — Regular Meeting.

Vice President GOODELL in the chair.

Correspondence and donations announced.

The following notes, received from Dr. HENRY SHIMER, of Mt. Carroll, Ill., were comunicated by Mr. Putnam:

On Sept. 20, 1864, about 9 A.M., a mild delightful autumn morning, while walking in the field, I passed by a previously observed nest of humble bees. This in the working season had been a powerful colony. At this time I was particularly attracted by a number of the bees flying about the hole, or remaining poised in the air a short distance from the hole as if in the act of fanning the opening. A little observation convinced me that these were all male or drone bees; I then ventured nearer and tore the nest out of the ground. Several large female or queen bees came out of the nest and crawled or fluttered slowly along over the ground. Now the males, which I previously saw flying around and fanning at the hole, eagerly darted upon these females. Four males darted at the first female that came out of the nest piling upon each other over the back of the female, wrestling and struggling with might and main for the prize. One more philosophical than the rest, observing the crowd upon her back, alighted on her side and twisted around beneath embraced her belly to belly, and thus formed in the midst of the excited struggling crowd the sweet nuptial embrace. I saw several such piles of two, three, or more males on one female.

The fanning at the hole which I observed by the males, was either anxious watching for the exit of the female, or their insect method of wooing, enticing them to come out, not being willing to deprive them of their virginity unwillingly within their habitation.

The neuters were all gone, no honey in the nest, which was full of worms. The bees remaining manifested none of that combative disposition which we always observe in midsummer.

I have seen many nests of the humble bee at all times during the whole summer, and never, however hot the day, have I seen them fanning at the hole during the breeding seasons. I am, therefore, convinced that Mr. Angus was wrong in his opinion that the fanning was for the purpose of introducing air into the nest. If this could be the object, then in the hottest days of midsummer it would be really if ever, needed, but then I have never seen it, on the contrary it is only in autumn that I have seen this interesting phenomena, the object, of which I am well satisfied, was in all cases which I have observed, the same as I verified by opening the nest as above set forth.

Mr. A. HYATT described the geological structure of the region of the Adirondacks and its border of fossiliferous rocks, and exhibited some specimens gathered during the past summer from those fossiliferous strata, and in other parts of New York State.

The central region of the Adirondacks is bordered on all sides, except where a narrow neck of primitive rock connects with the primitive rocks of Canada, by fossiliferous strata containing numerous remains. This shows that at one time this mountainous region was a peninsula almost wholly surrounded by water and the fossils enable us to repeople the sea with the strange plants and shells which then inhabited its beaches. No fishes enlivened the shallow sea, but the bottom was carpeted by succulent, thick stemmed seaweeds, and where stretches of bare ground intervened, crabs not unlike our horseshoe were strewed over the solid beds of lamp shells, now represented on our coast by only two species. The climate was mild and there is every reason to believe that the whole surface of the peninsula was devoid of vegetation, an arid, barren waste, like all the other

dry land at this early period of creation. From the earliest beginning of life in this period until the introduction of fishes there is a series of gradual changes in the character of the animals and plants, but no sudden cataclysms or miraculous creations. The new forms which appear are intermingled more or less with the old, and the whole is a gradual progression, in which the first created and simplest are almost imperceptibly supplanted by more highly organized beings.

Mr. F. W. PUTNAM followed Mr. Hyatt, and alluded to the fact that Lake Champlain having been an estuary of the ocean at a comparatively recent period, that of the Quaternary, as shown by the remains of marine shells and other marine animals found in the clay banks of the lake were identical with species now living on the coast of Maine.

It is a matter of some interest to ascertain where the fresh water fishes and other animals now inhabiting the lake came from. On making a comparison of the fishes of Lake Erie with those of Lake Champlain he was satisfied that the majority of the species were the same, and that Lake Champlain had been supplied with its inhabitants from the Great Lakes and the rivers flowing into the lake.

Mr. E. S. MORSE stated that the same faunal connection was shown in the mollusca of that lake, and mentioned several species identical with those of the Great Lakes and unlike any found east of Lake Champlain.

Mr. MORSE mentioned that he had found among the collection of shells made by Mr. Joseph True of Salem, which had been presented to the cabinets of the Institute by a friend, several interesting specimens, one of which, a species of *Limnadia*, belonging to the order of Phyllopoda, appeared to be entirely new.

The following communication was received from CHARLES WRIGHT, of Cambridge:

AMMANNIA LINGULATA, *Gris.*: — Mr. Grisebach established this species on specimens from Cuba, and it may interest botanists to know that it belongs also to the United States. The only distinctive character assigned is the short style. This at once suggested the idea that it might be a case of dimorphism now known to be so common. As I have just given these plants a patient examination I will state the conclusions to which I have come. So far as the specimens at my disposal indicate, *A. lingulata* Gris. is a stout plant, with larger flowers, larger fruit and seeds, twice the size of those of *A. latifolia* Linn. as well as different in form and color. These all, of themselves, would not be sufficient, perhaps, if the dimorphism could be shown. But in this latter case, generally, if not always, the extraordinary development of one organ or set of organs is accompanied by the greater or less reduction of the other. In our plant such is not the case. The stamens and style are quite hidden within the calyx, and the filaments are very short, while in *A. latifolia* both are exserted. It is, however, but fair to say, that in a specimen from Illinois, I saw one or two styles somewhat lengthened. I have examined specimens of *Ammannia humilis* and find in them no sign of dimorphism.

The seeds of *A. latifolia* are darker in color, or of a light brownish,

concavo-convex, incurved at the ends, and little, or not at all angled on the inner (concave) side by the funiculus. Those of *A. lingulata* are yellowish or pale straw color, and very perceptibly angular on the convave side. The leaves are so much alike that a character can hardly be drawn from them. On the whole, then, though not quite convinced that we have allowed, all these years, two species to pass under one name, the differences indicated above, if not sufficient to satisfy all that we here have two well marked species, they are interesting enough to excite farther enquiry, and to settle the question one way or another.

Some one may, very naturally ask, how shall we know which is the original *A. latifolia.* This I cannot tell, and I fancy it can only be decided by reference to the original so named by Linnæus. Mr. Grisebach's Jamaica specimen has the long stamens and style. In Cuba, so far as I can judge by my specimen, it must be rare; as nearly all that I have dried there belong to *A. lingulata.* If Mr. Grisebach's attention had been directed to this point when in the new Herbarium, he might have decided it and perhaps he did.

MONDAY, JANUARY 27, 1868.—Regular Meeting.

Vice President GOODELL in the chair.

Correspondence and donations announced.

Mr. G. L. STREETER read a very interesting paper on Salem as it was one hundred years ago. He described persons, places, incidents and social customs with vividness, and presented a graphic picture of the old town as it appeared just previous to the breaking out of the Revolutionary War.

He commenced by an account of the establishment in Salem, in 1768, of the Printing Press of Samuel Hall, our first printer, and the projector of the "Essex Gazette," and proceeded to give a minute statement of the conditon of the town as it then was. He sketched the outlines of its exterior appearance, the streets, public and private buildings, and street scenes and daily life, describing with particularity some of the more elegant residences, and giving detailed accounts of the Churches, Taverns, and of the old Town House and other public buildings on School street. He then passed to an account of the business of the place, its commercial interests, the wharves and shipping. The state of public opinion upon religious and political subjects was also spoken of. The social condition of the place, the style of dress, the modes of travelling, the amusements and recreations of the community were reviewed at length. The principal inhabitants and social aspect of the town were touched upon in passing.

The political status of the town with reference to the approaching revolution was exhibited quite fully, with the purpose of showing the violence of the contest, the nature of the feelings and sentiments involved, and the progress of events. The principal persons in the town on each side were introduced and particularly noticed. The exciting events at about the time of Gov. Gage's visit here occupied considerable attention, and he gave a personal account of the princi-

pal tories who were driven from the town, and also of the leading whigs who remained to control its society.

On motion of Mr. J. KIMBALL the thanks of the Essex Institute were tendered to Mr. Streeter for his interesting communication, and a copy of his paper was requested for the archives.

Benjamin W. Russell, Lucy Houghton Upton, George B. Appleton, Samuel H. Smith, Benjamin Whitmore and L. F. Warren, all of Salem; and Francis Baker of South Danvers, were elected Resident Members.

MONDAY, FEBRUARY 3, 1868. — Regular Meeting.

Vice President GOODELL in the chair.

Correspondence and donations announced.

Mr. HORACE MANN of Cambridge delivered a lecture, introductory to a course, on Elementary Botany.

MONDAY, FEBRUARY 10, 1868. — Regular Meeting.

Vice President GOODELL in the chair.

Correspondence and donations announced.

Mr. R. S. RANTOUL read a paper upon the past and present modes of travel and conveyance, a large portion being devoted to the history of the Eastern Stage Company, derived mostly from its records now in the possession of the Institute, and presented a very graphic picture of travel in the old stage coaches and life upon the road.

On motion of Mr. PUTNAM the thanks of the Institute were tendered to Mr. Rantoul, and the paper was referred to the Publication Committee.

William O. Johnson of Salem was elected a Resident Member.

MONDAY, FEBRUARY 17, 1868. — Regular Meeting.

Vice President GOODELL in the chair.

Correspondence and donations announced.

The hour of the meeting was occupied by Mr. HORACE MANN of Cambridge with his second lecture on Botany.

Some specimens of *Beche de mer* having been placed upon the table, elicited remarks from Messrs. G. D. PHIPPEN, F. W. PUTNAM, and G. A. PERKINS, on its natural history, and the mode of preparation as an article of commerce with the Chinese. Mr. PUTNAM gave an ac-

count of a peculiar genus of fishes (*Oxybeles*) which have been taken from Holothurians.

Benjamin F. Spinney of Lynn was elected a Resident Member.

MONDAY, FEBRUARY 24, 1868. — Regular Meeting.

Vice President GOODELL in the chair.

Correspondence and donations announced.

The CHAIR read the programme of a course of lectures to be delivered in the Lyceum Hall, under the direction of a committee of the Institute, commencing on Thursday, March 5.

JONATHAN KIMBALL read a communication on the School Houses of the olden times, more especially those that were found in our country towns, contrasting the condition of things in the early period of our history with that of the present day. The paper was one of much interest and value, and it enlisted the undivided attention of a large audience.

On motion of Dr. G. A. PERKINS, the thanks of the Institute were tendered to Mr. Kimball for his valuable communication, and a copy of the same was requested for deposit in the archives.

The CHAIR, Messrs. PHIPPEN, KIMBALL, UPHAM and others, made remarks, suggested by the paper of the evening.

Mason Harris of Marblehead was elected a Resident Member.

MONDAY, MARCH 2, 1868. — Regular Meeting.

Vice President GOODELL in the chair.

Correspondence and donations announced.

Mr. HORACE MANN of Cambridge occupied the hour with his third lecture on Botany. Subject: the formation of cells in the structure of stems.

MONDAY, MARCH 9, 1868. — Regular Meeting.

Vice President GOODELL in the chair.

Correspondence and donations announced.

Dr. HENRY WHEATLAND read a paper containing notes on the Teachers of the olden times; also a brief account of female education in the Public Schools of Salem.

Dr. W. stated that his subject was suggested by the highly interesting communication read at the last historical meeting by Mr. Kimball,

the able Superintendent of Schools in this city, on the "School Houses of the olden time."

Rev. John Fiske was the earliest teacher. He was born in 1701, and removed to America in 1637, and resided at Salem three years, performing the double office of preacher and tutor. Among his pupils was the famous Sir George Downing. After giving an account of Mr. Fiske and his descendants, Dr. W. mentioned the other succeeding teachers in the early years, Edward Norris, Daniel Epes, Samuel Whitman, John Nutting, Peter Frye, William Walter, Nathan Goodale, John Watson, Isaac Hooker, Edward Lang, and others. In this connection allusion was made to two of the old school mistresses, who kept private schools for a long period, Mrs. Susanna Babbidge, and Miss Mehitable Higginson.

The first provision made for female teachers in Salem, was in 1764. In 1793 girls were first admitted to the Grammar schools, though under very unfavorable conditions. In 1827 the first permanent arrangement was made for female education, by the establishment of two female Grammar schools, one in the eastern and the other in the western section. From that time the new system became more fully developed. In 1845 the High school was organized and became one of our highest and most valuable seminaries. A particular account was given of the origin of the Normal school in Salem, dedicated in Sept., 1854. The union of the High and Classical schools in the new building in Broad street extended the advantages of a good classical education, which under the old system was very imperfect. The city is much indebted to the late Hon. S. C. Phillips for awakened zeal in these matters which still continues with unabated vigor.

On motion of Mr. E. S. Morse, this paper was referred to the publication committee. Remarks were made by Mr. Kimball, Superintendent of Schools, and others.

Mr. W. P. Upham read a copy of the earliest reference on the town records to a free school, viz.: Sept. 30, 1644. Also a deed by John Cross of Ipswich, dated Dec. 6, 1650, giving ten shillings a year forever, for a free school in Ipswich, and binding his farm therefore.

Mr. Kimball referred to the origin of free schools in Dorchester.

William H. Hull, of Salem, was elected a Resident Member.

Monday, March 16, 1868. — Regular Meeting.

Vice President Goodell in the chair.

Correspondence and donations announced.

Among the donations particularly noticed were specimens of the Black Rat, taken at Hancock, N. H., presented by Mr. Benj. Goodhue of that place. This rat, once better known than the brown rat, is rapidly diminishing since the introduction into its haunts of the latter species. Its original locality is not well known. According to some authors it was brought to this continent about the year 1544, and spread to such a degree as to have been apparently more abundant here than in the old world. Other authors have insisted that the species originally came from America, but of this there is much doubt.

Another addition to the Museum deserving of special notice is a

beautiful specimen of "Venus' Flower Basket," *Euplectella speciosa*, from the island of Zebu, of the Philippine group, presented by Capt. DANIEL H. HUTCHINSON. This is a silicious sponge attached by its expanded base to some marine body, supported by a skeleton, of a cylindrical tubular form, composed of numerous elongated fibres, consisting of fascicules of very long slender spicules, forming a square network, which, with its lightness, elegance and rigidity, give the idea of a beautiful, complicated piece of glass lace work.

Mr. HORACE MANN of Cambridge gave the fourth lecture of his course on elementary Botany.

He spoke of the growth of the stem, the vascular tissue, medullary rays, the bark and its uses; cork, which is a growth of the bark of some trees, more especially of the *Quercus suber*, or cork oak of southern Spain; the mode of collecting and preparing for commercial uses the *liber* of some plants used for cordage and various textiles. The deposit of vegetable or mineral matter in the cells gives the different degrees of hardness to the wood, and hence its adaptability for various uses in the arts. He also noticed the uses of pith, as the Sago in some species of Palm; Rice Paper, obtained from a species of Aralia, and the manner of obtaining and preparing the same by the Japanese.

He then alluded briefly to the growth of the Endogens, and described the germination of the cocoanut, one of the largest and noblest of this part of the vegetable kingdom, and closed his remarks by speaking of adventitious roots, and the growth of abnormal stems, as in the Dutchman's Pipe, one of the most simple of these aberrant forms, consisting of alternate layers of wood and bark, the new growth forming outside of the bark instead of pushing the bark out and forming a layer within; another form where the growth fails on one side of the stem and makes the increase on the opposite side, as in some vines. The mention of other forms of peculiar growth of the stems of plants concluded the interesting lecture.

Joseph Adams, of Salem, was elected a Resident Member.

MONDAY, MARCH 23, 1868.—Regular Meeting.

Vice President GOODELL in the chair.

Correspondence and donations announced.

Among the letters read was one from R. S. RANTOUL, Esq., tendering to the cabinets the die and wax impression taken therefrom, of the seal of the naval office for the district of Salem and Beverly. This die was given to Mr. R. by a gentleman who bought it in Boston with a collection of rare coins, medals, etc., and desired that it should find its way to the Institute.

The naval office was abolished by act of Congress, approved Feb. 28, 1865. When it was established is not known to the writer. Salem has been a port of entry since Feb. 7, 1683. The die has a pine tree in the centre surrounded by the words "Naval Office, District of Salem and Beverly." The pine tree was a favorite device in New England. It was on the coinage as early as 1652, and on the flag of

Independence adopted by our General Court, April 11, 1776, a white flag, with a green pine tree in the middle. This flag, the first standard bearer of liberty, was hoisted at Salem, Felt thinks, as early as March, 1775, and Salem was the first place reported in England as having raised it. Mr. R. writes that no such die as this has been used at the Custom House for many years, and is unable to give any satisfactory account of it.

Mr. GEORGE D. PHIPPEN occupied the hour of the evening in pleasant and interesting remarks on some points in botany, suggested mainly by the lectures which Mr. Horace Mann is delivering at the rooms of the Institute on alternate Monday evenings.

Botany may be considered under four great heads, or divisions. Physiological, Systematic, Geographical and Palæontological. He chose for his subject the first of these divisions, and spoke of the cells, the vascular tissue, the circulation and the growth of plants. Plants may be arranged under four heads: 1st, *Thallogens*, as the mushrooms, lichens and sea-weeds; 2d, *Acrogens*, consisting of ferns, lycopods, etc.; 3d, *Endogens*, or inside growers, as the grasses, corn and lilies, etc., but characterized in the tropics by the noble palms; 4th, *Exogens*, or outside growers, combining our trees, shrubs and most of the flowering plants. He concluded by speaking of the Cambium and Bass tissue, the latter of which constitutes the material used in the various textiles, and showed specimens which were obtained from the Roxbury waxwork, and the milk weed. He also alluded to the lactiferous vessels, which, however, are only found in some plants, and from them are derived India Rubber, Gutta Percha, etc. The most common with us are the milk weeds, celandine, and some of the composite plants.

Lizzie H. Smith, David Pingree Waters, John Henry Goldsmith, all of Salem, were elected Resident Members.

MONDAY, MARCH 30, 1868.—Regular Meeting.

Vice President GOODELL in the chair.

Donations and Correspondence announced.

Mr. HORACE MANN gave his fifth lecture on Botany. Subject: the leaf, its development, death and fall, sensitiveness, situation on the stem, etc., etc.

MONDAY, APRIL 6, 1868.—Regular Meeting.

Vice President GOODELL in the chair.

Mr. F. W. PUTNAM was elected Secretary pro tem.

Donations and correspondence announced.

The Secretary read by title a paper from EDWARD NORTON "on Mexican Ants," referred to the Publication Committee.

The CHAIR presented a Pitch-pipe in the name of SAMUEL DAY, and

remarked upon the value and rarity of the instrument, and gave an account of its history and use. The chair also read a note from JOHN H. SEARS, of Danvers, stating that several Hawks and Owls had commenced building their nests. The chair also called attention to several hymn and other books in possession of Capt. DAY, of Salem.

Mr. GEORGE L. VOSE of Paris, Me., was introduced and gave an account of the formation of glaciers. The following is a brief extract of his remarks: —

The existence of the glaciers depends upon the occurrence, in certain parts of the earth, of large masses of perpetual snow. The first question then to be answered, in the study of the glaciers in their physical aspect, is, what are the conditions under which snow lies upon the ground summer and winter, year after year; in fine, what is the cause of perpetual snow? In the common course of nature the water which falls from the clouds is disposed of in three ways: by sinking into the ground, by evaporating from the surface, and by flowing off from the higher to the lower lands in the form of rivers, by which it is carried to the sea; from the sea it is evaporated, to be condensed into rain and again thrown down upon the surface of the earth. But in order that this circulation may go on, the water must remain in the liquid form, — it must be water. Below a certain temperature water becomes ice, and whatever moisture falls from the clouds, falls not as rain, but as snow, or hail or ice. The higher regions of the atmosphere are in a great degree deprived of the solar heat reflected from the earth, and enjoy only the direct heat from the sun, which is not enough to keep water in the liquid form. What then becomes of the snow which falls upon high mountains, where it is so cold that it cannot melt, and thus cannot escape in any of the methods employed for the circulation of water? Why does it not accumulate indefinitely upwards until the whole country is buried in everlasting snow? This question is answered by the existence and operation of the glaciers. At its upper end a glacier is snow; this snow is very gradually compacted into an immense river of ice, which forced along by the subsiding and pressing out laterally of the great mass of unconsolidated snow at the upper end, moves at the rate of from one to two feet in a day, and thus draws the snow off in a solid form from a high cold region where it could never melt so as to soak into the ground, or evaporate, or flow off to the ocean, and leads it down to a low warm region where it melts, and giving birth to a stream of water finds its way to the ocean, thus completing the circulation of moisture above referred to.

It is at first sight difficult to understand how ice can move through a long winding valley over all the roughness of the ground. Prof. Tyndall, however, has shown that the hardest ice, under certain conditions, behaves as a plastic mass. He actually moulded cubes of brittle ice into rings, spheres and other figures. The requisite conditions are pressure and time; immense compression, applied in a very gradual manner, forces the huge mass of the glacier along the windings of the valley, around the mountain spurs; welds together several tributaries into a main trunk, and gives to the whole mass a motion of precisely the same quality, though far less in velocity, as that of a river of water.

The great weight of the moving ice produces an effect upon the rocks and the ground over which it passes, which is not only of inter-

est in connection with the existing glaciers of the Alps, but is extremely instructive in a geological point of view, inasmuch as a careful study of the geological action of the glaciers of the present time gives us the key by which to unlock a volume which has been a long time closed; enables us to restore a picture which has long since vanished; to see the world at a time when not only the whole northern part of Europe, but also of America, was covered with vast fields of ice, which grinding along, over the tops of the highest hills, gave the finishing touches to the surface geology, and left their history plainly recorded upon the solid rocks in the shape of a polishing and furrowing of the hardest materials, and show us also that nature uses the same means now to accomplish her results as she did ages upon ages ago, long before man had appeared upon the scene.

On motion of Mr. W. P. UPHAM the thanks of the Institute were tendered to Mr. Vose for his interesting communication.

MONDAY, APRIL 13, 1868. — Regular Meeting.

Vice President GOODELL in the chair.

Mr. F. W. PUTNAM appointed Secretary pro tem.

Donations and correspondence announced.

Mr. HORACE MANN delivered the sixth lecture of his course. Subject: the structure of the flower and the various methods of fertilization, especially that of the orchids by insects.

MONDAY, APRIL 20, 1868. — Regular Meeting.

Vice President GOODELL in the chair.

Mr. F. W. PUTNAM appointed Secretary pro tem.

Correspondence and donations announced.

Mr. PUTNAM stated that the collection of Fossils received from Prof. JAMES HALL, in exchange, was quite valuable, the specimens having been identified and named by Prof. Hall.

Mr. PUTNAM read a letter from Mr. S. JILLSON, giving an account of the nest containing the white eggs of the Tawny Thrush presented at the last meeting. The nest was found in June, 1867, and the bird was seen, leaving no doubt as to the species. Mr. Jillson also wrote that he had found pure white eggs of the Blue Bird.

Mr. BENJ. S. DODGE presented a stone implement found in Rowley. This implement combined characters of the axe and gouge with a groove for a withe by which a handle was probably attached. In this connection Mr. PUTNAM alluded to the different forms of stone implements that had been found in New England, and stated that he was having drawings of the various kinds in the collection made for the

purpose of publishing an illustrated catalogue, and that the Institute would be pleased to receive all the specimens obtainable in order to render the catalogue as complete as possible.

MONDAY, APRIL 27, 1868.—Regular Meeting.

ROBERT BROOKHOUSE, Esq., in the chair.

Correspondence and donations announced.

The hour of the meeting was occupied by Mr. HORACE MANN with the seventh lecture of his course. Subject: fertilization of ferns and allied plants.

J. W. Furbush of Salem was elected a Resident Member.

MONDAY, MAY 4, 1868.—Social Meeting at Hamilton Hall.

The leading object at this meeting was to present a collection of the common animals found on our seashore and in some of the ditches and ponds of the vicinity. Very few persons in any community are acquainted with the vast field of nature that is everywhere to be found wherever they may direct their steps. One of the most prolific places in our neighborhood for specimens of marine animals and plants, is around the piers of Beverly bridge, in the channel of the river, at low tide. A visit there would well repay any one, and even excite the wonder and admiration of the most indifferent observer at beholding the beautiful specimens and the great variety that are presented to his view. Several members of the Institute collected a goodly number and variety of animals and plants which were placed in a series of aquaria arranged on tables occupying three sides of the Hall.

The specimens were all duly labelled and from the cards we copy the following: Hermit crabs, sea anemones, crabs, lobsters, sponges, vorticellæ or cup animals, young jelly fishes, star fishes, sea urchins, muscles, sea snails, tom cods, hydroids, etc.; also, of those living in fresh water, were the caddis worms, leeches, perch, pout, three species of turtles, larvæ of insects, etc.

The meeting was called to order by Vice President GOODELL, who, after a few appropriate remarks, introduced Mr. E. S. MORSE, the lecturer of the evening. Mr. Morse gave a brief and very comprehensive description of the structure and habits of several of the species which were in the aquaria, directing his attention more especially to the mouths and the manner in which each derives its nourishment; also the mode in which the jelly fish is propagated, etc.

After the closing of Mr. Morse's address, an opportunity was afforded to examine the various objects in the different aquaria. The

minute forms of living animals and plants, sections of the spines of sea urchins, skin of the shark, scales of the flounder, etc., were placed under some dozen microscopes in charge of Mr. EDWIN BICKNELL, for the purpose of illustrating some points in the anatomical structure peculiar to these lower forms of animal life. Many of the above preparations were beautifully executed by Mr. Bicknell, who has acquired a well deserved reputation as a skilful preparator of slides for microscopical investigations.

There was also on the tables a Wardian case belonging to Mr. JOHN ROBINSON, containing a beautiful collection of growing ferns and other plants, which attracted much attention and added greatly to the interest of the exhibition.

After a sufficient time had been appropriated for the examination of the various specimens, the collation was announced, and while the company were paying their attention to this portion of the entertainment, the tables, aquaria, and microscopes were removed to the lower hall, where those who desired could devote more time to farther investigations.

MONDAY, MAY 11, 1868. — Regular Meeting.

Vice President GOODELL in the chair.

Correspondence and donations announced.

A communication was read from Mr. JOHN H. SEARS, of Danvers, on the return of the Birds.

Mr. D. B. HAGAR made some interesting remarks on ventilation, which he designated familiar talk. He proposed three questions: — first, what is bad air? second, where is bad air? third, how to get rid of bad air? The last is the most important practically, and various methods were suggested. The subject was illustrated by several very simple and appropriate experiments.

Discussion followed, participated in by Messrs. KIMBALL, HAGAR, and GOODELL.

A vote of thanks was passed, with the request that Mr. Hagar would give these remarks in a lecture, the next season, with such additions as may be suggested.

Edward Lane, S. Augusta Brown, and Laura S. Spiller, of Salem, were elected Resident Members.

WEDNESDAY, MAY 13, 1868. — Annual Meeting.

Vice President GOODELL in the chair.

Records of the last annual and regular meetings read.

The Annual Reports of several of the officers were read and accepted.

The SECRETARY, in his report, stated that the scientific collections, in conformity to a vote of the Institute passed at a special meeting held in May, 1867, have been deposited with the Trustees of the Peabody Academy of Science in the East India Marine Hall, and will be arranged with the Museum of the East India Marine Society in the new cases made for that purpose. The Museum thus arranged will constitute one of the finest in the country and in some of the departments will be unique.

The large room on the first floor of Plummer Hall formerly used for the Museum, is now arranged for newspapers, pamphlets, and those books not intended for circulation; the area in the centre will accommodate some two or three hundred persons, and is well adapted for the lectures and meetings of the Institute. The cases in the eastern ante-room on the same floor will accommodate the Manuscripts and Historical Collection. The western ante-room has been fitted with a gallery for the deposit of the Periodicals and other works received in exchange; also for the records and publications of the Society.

MEMBERS. — Eighty resident and three corresponding members have been elected during the year. Notices of the decease of twelve of the former and three of the latter have been received. Fourteen of the former have removed or retired. The present number is seven hundred and eighty-five; — five hundred and ninty-nine Resident, one hundred and eighty-six corresponding.

Biographical notices of the following deceased associates will be prepared for the *Historical Collections*: — Mary Doyle, died in Salem, July 16, 1867, aged seventy-one years, nine months and four days. N. A. Frye, died in Salem, January 5, 1868, aged fifty-two years, one month and eleven days. M. Hartney, died at Worcester, Wednesday, January 15, 1868. Henry S. Joselyn, died in Salem, January 26, 1868, aged forty-two. D. H. Johnson, died in Salem, February 14, 1868, aged sixty-four years, one month and two days. Edward D. Kimball, died in Paris, France, September 22, 1867, aged fifty-six. N. J. Kinsman, lost at sea. S. Mackintire, died at Salem, Wednesday morning, January 24, 1868, aged fifty-six years. Jeremiah Page, died at Salem, November 1, 1867, aged seventy-one years and five months. Francis Peabody, died at Salem, October 31, 1867, aged sixty-five years, ten months and twenty-four days. George F. Read, died in Salem, October 4, 1867, aged fifty-six years, eleven months and twenty-two days. W. S. Roberts, died October 21, 1867, aged sixty years. Joseph Torrey, died at Burlington, Tuesday, November 26, 1867, aged seventy years. J. A. Andrew died at Boston, Wednesday, October 30, 1867, aged forty-nine years. C. G. Page, died at Washington, D. C., May 5, 1868, aged fifty-six.

MEETINGS.—Five Field Meetings have been held during the past season. At Haverhill, July 2; at Andover, July 16; at Beverly Farms, August 1; at Kittery, Me., August 22; at Ipswich, October 4. They were very successfull and largely attended, and at every place received the kind attentions of the citizens and a cordial welcome. The meeting at Kittery was the first one held beyond the limits of the State. Our thanks are due to the friends of the Institute in these several places, and to the directors, superintendents and other officers of the Eastern and Boston and Maine Railroads for the courtesies extended on these occasions.

The Quarterly and Regular Monday Meetings have been held during the wintry months as usual. Two Microscopic Meetings, of a social character, one on Monday evening, January 6, the other on Monday, May 4, were well attended and passed off very pleasantly.

LECTURES.—A course of seven lectures on Botany by Mr. Horace Mann of Cambridge, was delivered in Plummer Hall on alternate Monday evenings during the months of February, March and April. These lectures were repeated before the Boston Society of Natural History. Mr. Mann treated his subject in a very lucid manner and gave evidence of becoming one of our most instructive lecturers on the study of Botany.

Also a course of seven lectures in the Lyceum Hall: first, on Thursday, March 5, by Mr. E. S. Morse of Salem, on the different modes in which animals eat, commencing with the lowest forms among the radiates and tracing the gradual modifications which the organs of mastication assume in the several classes of the animal kingdom. Second, on Thursday, March 12, by Mr. M. G. Farmer of Salem, with experiments illustrating the various discoveries that have been made in Electricity, Electro-magnetism and the kindred subjects. Third and fourth by Capt. N. E. Atwood, of Provincetown, on Fishes and the Fisheries, on Thursday, March 19 and 26. Fifth, by A. C. Goodell, jr., Esq., of Salem, on the History of Church Music, Thursday, April 9. Sixth, by A. C. Goodell, jr., Esq., Thursday, April 16, on Church Psalmody and Hymnody previous to the present century. Seventh, by General H. K. Oliver, of Salem, Thursday, May 4, on Ancient Music. The last three lectures were interspersed with illustrations by an excellent choir and orchestra. Many of the old favorite fugues and other tunes were sung with great skill and excellent effect, and in the Coronation, St. Martin's and Federal Street, the whole audience were requested to join. The success of these musical lectures encourages the hope that similar lectures, with illustrations, may hereafter be acted upon by the Institute.

THE CORRESPONDENCE continues to increase in consequence of the more extended circulation of the different publications. The letters

have all been arranged into volumes and indexed so that they are accessible for reference.

THE PUBLICATIONS OF THE HISTORICAL COLLECTIONS and the PROCEEDINGS have been continued as in past years. They are well received by kindred societies with whom a system of exchange has been established. It is desirable that these should be maintained to a high standard, and to do so additional efforts should be made to provide suitable means for this desirable object.

THE HORTICULTURAL EXHIBITIONS were omitted the past season in consequence of the scarcity of fruit and the presumed uncertainty of having a display that would be creditable to the cultivators in this county.

THE TREASURER presented the following statement of the financial condition for the year ending May, 1868.

GENERAL ACCOUNT.

Debits.

Athenæum; Rent, half Fuel and Librarian	$420 88
Publications, $1265 07; Salaries, $820 65; Gas, $12	2097 72
Express, etc., $172 05; Sundries, $231 08	403 13
Two shares in Printing office, $200; Social Meetings, $293 36.	493 36
To Historical account	53 15
	$3468 24

Credits.

Balance of last year's account	$29 92
Dividends of Webster Bank, $45; Sundries, $28 52	73 52
Field Meetings, $36 95; Social Meetings, $381; Lectures $271 05	689 00
Peabody Academy of Science, services of Janitor, $299 33	
" " " on account 250 00	643 33
Salem Athenæum, for Janitor's services 94 00	
Donations:—F. Peabody, $100; J. S. Cabot, $50; J. Bertram, $100; J. G. Felt, $10; Adams & Richardson, $11 13	271 13
Sale of Publications, $631 74; Assessments, $1028	1659 74
Natural History and Horticultural Account	6 30
Balance Account	95 30
	$3468 24

NATURAL HISTORY AND HORTICULTURE.

Debits.

Preservatives and Taxidermy	$65 70
Deposit in Savings Bank	100 00
To General Account	6 30
	$172 00

Credits.

Lowell Bleachery dividend	$160 00
Portland, Saco and Portsmouth Railroad	12 00
	$172 00

HISTORICAL ACCOUNT.

Debits.

Binding, $108; Repairing, $3 15	$111 15

Credits.

Naumkeag Bank dividend	$20 00
Michigan Central Railroad	38 00
From General Account	53 15
	$111 15

THE LIBRARIAN reported that the additions to the Library have been as follows:

Folios 20; Quartos 32	52
Octavos and Lesser fold	344
Pamphlets and Serials	2559

The above have been obtained, with few exceptions, by exchange with editors and kindred institutions, and by donations from members and friends. These contributions have been received from two hundred and twelve different individuals and institutions, and may be classed as follows:—Editors, nineteen; Societies, sixty-eight; others, one hundred and twenty-five. A portion of the Library, consisting of the newspapers, pamphlets and many of the books of reference, not intended for circulation, has been deposited in the lower hall, thus furnishing accommodations for a suitable arrangement of this department.

THE SUPERINTENDENT OF THE MUSEUM stated that arrangements are in progress for carrying out the details of the agreement for the deposit of the scientific collections with the Trustees of the Peabody Academy of Science, and having the same properly arranged in the East India Marine Hall, in connection with the Museum of the East India Marine Society. The rearrangement is a laborious undertaking and it will be some time before sufficient progress will have been made to have the same open to public inspection. Several important additions have been made during the past year, and have been duly noticed at the regular meetings. The receipts in the various departments may be classified as follows: twenty-seven donors have contributed eighty-nine specimens of Indian implements of stone and bone, and other Archæological and Ethnological specimens; ten, thirty-four in the department of Comparative Anatomy; thirteen, eighteen of Mammalia; twenty-seven, fifty-six of Birds; four, twenty-nine of Bird's nests and eggs; eleven, fifty-six of Reptiles; nine, about one thousand of Fishes; thirty-nine, about two thousand five hundred of Insects; six, fifteen of Crustacea; four, twenty of Worms; sixteen, about two thousand of Mollusks; twelve, one hundred and two of

Radiates; four, six of Sponges; six, thirteen Geological; eighteen, about one thousand eight hundred Fossils; seventeen, about ninety of Minerals; ten, fifty to the Herbarium. Thus nearly eight thousand specimens have been received in the Natural History department.

Some twenty donations have been made to the Museum of the Historical department, not including the manuscripts and books.

While the collections are in this transition state a farther report cannot readily be made.

The following OFFICERS were elected for the year ending May, 1869:

President.

HENRY WHEATLAND.

Vice Presidents.

Of Natural History—S. P. FOWLER. *Of Horticulture*—WM. SUTTON.
Of History—ABNER C. GOODELL, JR.

Recording and Home Secretary.

A. H. JOHNSON.

Foreign Secretary.

A. S. PACKARD, JR.

Librarian.

ALPHEUS HYATT.

Superintendent of the Museum.

F. W. PUTNAM.

Finance Committee.

J. C. Lee, R. S. Rogers, G. D. Phippen, James Upton, S. Endicott Peabody, Robert Brookhouse.

Lecture Committee.

James Kimball, A. C. Goodell, jr., Wm. C. Endicott, George Perkins, G. D. Phippen, E. S. Morse.

Field Meeting Committee.

G. B. Loring, Samuel P. Fowler, C. M. Tracy, E. N. Walton, Charles Davis, A. W. Dodge, J. R. Nichols, H. C. Perkins.

Publication Committee.

A. C. Goodell, jr., William P. Upham, F. W. Putnam, C. M. Tracy, R. S. Rantoul, A. S. Packard, jr., E. S. Morse, Alpheus Hyatt.

Library Committee.

J. G. Waters, Alpheus Crosby, James Chamberlain, Henry J. Cross.

Curators of Historical Department.

W. P. Upham, Henry M. Brooks, M. A. Stickney, John Robinson, R. S. Rantoul, W. S. Messervy, James A. Gillis.

Curators of Natural History Department.

H. F. King, G. A. Perkins, C. M. Tracy, James H. Emerton, Caleb Cooke, G. Peabody Russell, Edwin Bicknell, E. S. Morse, Alpheus Hyatt, A. S. Packard, jr., Benjamin Webb, jr.

Curators of Department of Horticulture.

John M. Ives, J. S. Cabot, R. S. Rogers, G. B. Loring, John Bertram, S. A. Merrill, Wm. Maloon, Andrew Lackey, G. F. Brown, C. H. Higbee, E. S. Rogers, John F. Allen, Francis Putnam, Wm. Mack, B. A. West, G. D. Glover, A. W. Dodge.

Voted, That the election of Treasurer be deferred, and that the Treasurer of the preceding year be requested to act until a successor shall be chosen.

The following amendments to the By-laws were adopted:

CHAPTER II. To be added to first paragraph (of President) "He shall be *ex-officio* a member of all Standing Committees."

Third paragraph, before the word "Secretary" insert "Recording and Home."

The following to be added as a new paragraph:

"The Foreign Secretary shall have charge of the Foreign Correspondence and Foreign Exchanges of the Publications of the Institute."

CHAPTER III. The three first sections to be expunged.

George Wheatland, jr., of Salem, and Mary E. Breed of Lynn, were elected Resident Members.

MONDAY, JUNE 1, 1868. — Adjournment of Annual Meeting.

President in the chair.

Records of last Meeting read.

Donations and correspondence announced.

Mr. W. P. UPHAM presented a coin, in the name of Mr. E. G. JOHNSON, and read the following account of the same prepared by Mr. M. A. Stickney.

"It is a double Tournois of Louis XIII, 1639, found near the Salem Horse Railroad Office, near the tunnel, in excavating for the new aqueduct in 1868. This piece was coined at Tournage, France, and was, at that time (1639), of double the value of one of the earliest French coins called the Denier, from the Latin Denarius, a silver piece of the value of a penny and which at that time had decreased so much as to be represented in copper."

Mr. UPHAM stated that the coin was probably used and lost near the time of the coinage by one of the early French settlers.

After the transaction of some general business the meeting adjourned.

THURSDAY, JUNE 11, 1868.—Field Meeting at Saugus.

This day a small but zealous representation of the members of the Institute met at the Eastern Railroad station, according to appointment, at 10 A.M., to start for Saugus to hold the first Field Meeting of the present year. A lowering sky strongly hinted the propriety of a postponement, but with unextinguished ardor the happy few took the train for the field.

Arrived at Saugus they were conducted to the Town Hall, where Mr. WILBUR F. NEWHALL and others gave information concerning the various places of interest in the town, and proffered guides to any parties that might be formed to visit them. Several parties were formed and succeeded in making their chosen tours, and in returning to the Hall before it rained. This was a matter for general congratulation, which heightened into unusual satisfaction when it was found that the objects of the different excursionists had been, for the most part, attained and that the friends had, with much liberality, provided for the hospitable entertainment of their visitors in welcome additions to the usual collation.

One party had an opportunity to visit Dungeon Rock, where Mr. Hiram Marble and his son are still engaged, under the direction of clairvoyants, in searching for the traditional Pirate's Cave and hidden treasure, said to have been buried by the great earthquake of 1658. The story of the pirate's retreat and fate, for which there is no recorded authority older than that of the late Alonzo Lewis, in his history of Lynn, is too familiar to need repetition here. Those who wish to peruse the story in full can consult Mr. James R. Newhall's valuable edition of Lewis' History of Lynn, which is greatly enriched by the editor's additions and comments.

The elder Marble was not at home on Thursday, but his son did the honors of the Dungeon Rock very acceptably. The excavation which they have made in the solid rock extends along an irregular opening into the bowels of the earth, some two hundred feet, more or less, when lighted by lanterns at suitable intervals, admitting of a not difficult passage, to any one who wishes to explore its recesses, upon the payment of an admission fee of fifteen cents. They have been engaged seventeen years in their labors and their patience is not yet exhausted. Their blasting processes are only carried on in the winter, when they expend the funds they receive from visitors in the summer, the direction being determined by the instructions conveyed through the spiritual mediums consulted by them. The spot is very romantic and picturesque, and well worth a visit, aside from any traditional interest with which it is supposed to be invested. There is a good road to the foot of the hill, if you only succeed in finding the right one, and the view from the summit of the rock is extensive and beautiful. Several portraits, photographs, drawings and relics, are shown, and a

pamphlet, purporting to be a (spiritual) history of the place and its former occupants, as well as some of the photographs, can be purchased for a suitable consideration. The visitor may believe as much or as little of what he reads and hears as his credulity will allow, but he cannot fail to be interested during the time spent there, and charmed with the wild and romantic beauty of the scenery, and the extensive panorama spread out before him.

At the hour appointed for the addresses and discussions the hall was well filled by an auditory consisting largely of the residents of Saugus.

The meeting was called to order at 2.45 P.M. by the PRESIDENT.

Records of the last meeting read; donations and correspondence announced.

The President called upon WILBUR F. NEWHALL, Esq., to give some information concerning places of interest in Saugus.

Mr. Newhall accordingly entered upon an interesting narrative, in the course of which he stated that the first foundry in this country was established at Saugus by Joseph Jenks, in the years 1643-4. A company was first chartered in London, and Joseph Jenks, who was a skilled workman, and a man of inventive genius, conducted its business successfully. There remains a bank of cinders extending from the foundry to the mill-pond marking the extent of the business. The ore was smelted from what is commonly called bog-ore, taken from a neighboring meadow. The foundry produced from eight to ten tons of iron per week. The first casting is said to be an iron pot, now or recently in the possession of the family of the late Alonzo Lewis, the historian of Lynn. Mr. Lewis, we believe, was a descendant of this Joseph Jenks. The present dam is fifteen feet lower than the old dam. At first a dam was built this side of the present, but finding an insufficiency of water they built farther down the stream. Joseph Jenks continued the foundry business for over forty years.

He made the first dies for coining money in the colony, which consisted of the pine-tree shilling, and six and three penny pieces, bearing the date of 1652. These are highly valued by the coin collectors of the present day. Other inventions, which were highly esteemed by the colonists of that early period, are attributed to him.

[A son of Mr. Joseph Jenks, jr., who was born in England, came to this country a few years after his father, worked for some time in Lynn, then removed to Pawtucket, R. I., where he built a forge, the first in that colony, which was destroyed in King Philip's war. He lived to a good old age and was highly esteemed. Some of his descendants, in the second and third generation, were persons of note; one of them for five years occupied the Gubernatorial chair. The late Elias Jenks, of Salem, a noted shipbuilder some thirty years since in this city, was a descendant, and was born in Rhode Island. He came to Salem when a young man, and possessed many of the traits of character, especially the mechanical genius, of the emigrant ancestor.]

Mr. Newhall also alluded very appropriately to some of the changes that had taken place since the meeting of the Institute at Saugus in 1859, and spoke of several persons interested in that meeting, who have since been enrolled among the departed worthies of that ancient town.

Mr. F. W. PUTNAM of Salem, exhibited several zoölogical specimens found during his rambles, such as the eggs of the wood turtle, several species of frogs, dor-bugs, etc., etc. In answer to inquiries which were made, he gave some highly interesting information concerning the habits of the specimens exhibited, and also spoke of the damage done to vegetation by insects, alluding to the ravages of the canker worm for several years, and its apparent disappearance the present season in several localities where it had been very abundant for a few preceding years. This he accounted for by the parasitic insects which feed upon the worm and consequently check its increase for a time.

The PRESIDENT remarked that the present season has been very favorable to all vegetation; the fields never looked greener than at this time; the specimens of flowers were abundant and looked finely. Flora appears to be in the ascendant. The collections of botanical specimens were very large. He called upon Mr. C. M. TRACY of Lynn, who greatly instructed the audience with his comments upon many of the plants and flowers, taking up the several species and narrating the peculiarities of each.

Mr. S. P. FOWLER of Danvers, being called upon, said that he wished to speak of the value of old books and papers, "just the stuff we make history of," and offered a vote of thanks to Mrs. Jonathan Newhall, of Saugus (who had that day presented several old volumes to the Library of the Institute) which was unanimously adopted.

Mr. A. C. GOODELL, jr., of Salem, spoke of the historical reminiscences, and detailed his visit to an old house which was undoubedtly built by one of the early workers at the foundry. He mentioned several interesting facts in connection with the iron works; also of the coining of money in the colonies; and commented upon the appropriate names given by the early colonists to several places in this vicinity Thus, Brooksby was applied to what is now Peabody, being the place where several brooks were united; Hammersmith, to that part of Saugus near the old foundry, etc. Mr. Goodell, in graceful and fitting terms, spoke of Saugus as a favorable region for the Field Meeting of the Institute. Being at the junction of the fresh and salt water, it furnished specimens for the zoölogist. Its fields were fruitful to the botanist; its geological opportunities were excellent and it was an interesting historical region. Two hundred and twenty years ago the sound of the trip hammer ranged through these fields and

hills, and the work and name of Joseph Jenks filled no mean place in New England history. Mr. Goodell exhibited some pieces of iron which he found at the bank of cinders near the mill-pond, presumed to be fragments of castings from the old furnace.

Mr. W. F. NEWHALL followed Mr. Goodell and gave some additional facts about the "old house."

Mr. ALPHEUS HYATT, in response to a call from the President, reported that he had made an unsuccessful search for polyzoa. The species for which he was in quest being nomadic and capricious in their habits of life, he had, as often before, returned without them. A specimen of horse-tail rush upon the table led him to offer some interesting remarks upon the ancient vegetation of which this was a representative.

Mr. C. M. TRACY had examined the specimens of Iron presented by Mr. Goodell, and having had some practical knowledge of founding iron, was able to identify them as the sprue formed upon all castings, by the hole in the mould through which the moulten iron is poured. This is broken off when the mould is opened and thrown away.

Mr. E. N. WALTON of Salem, spoke of the pleasure it gave him to come once more to this favorite spot, and especially of his interest in the beautiful river running through and bearing the name of the town. He had often visited the source of the river, where at South Reading it starts from the lake in that town, a modest brook, and then flows on through Lynnfield forming for some distance the boundary line between that town and South Reading, acquiring strength from springs and numerous little streams, occasionally furnishing motive power for manufacturing establishments, and here, at the point of joining the tide water of the ocean, it gives life to the woolen mill where so many of the party had to-day witnessed the transformation of wool into flannel while the proprietor had kindly explained the successive processes of the manufacture.

Mr. W. alluded to the large number of children present at the meeting, and took occasion to speak of the value of object teaching, and was glad to learn that the excellent school teachers of the town had adopted this most efficient method of imparting instruction. Botanical text books were rendered immeasurably more valuable by practical illustrations and personal examination of the objects treated of. A better idea of geology could be planted and retained in the mind, by a single Field Meeting experience, than by weeks' of weary study of dry technicalities. And the principle holds good indefinitely as we take up one science after another. In addition to the intellectual advantages to be derived from the Field Meeting, the physical benefit arising from an occasional day of health-giving ramble in wood and dell, creating new life and vigor, could not be over estimated.

Mr. PUTNAM spoke of the interest now felt in the collection of relics

of the Indian race, and urged the importance of preserving such arrowheads and stone implements as may have been or may hereafter be found, and depositing them in the cabinets of the Institute.

Business of the Institute being in order, on motion of Mr. PUTNAM, a committee was chosen to take into consideration the subject of inviting the "American Association for the Advancement of Science" to hold its meeting of 1869 in Salem, and to have full power to act and make the necessary arrangements.

Mr. GOODELL read a letter from Pittsfield inviting the Essex Institute to hold a Field Meeting with the Natural History Society in that place during the present season. Action on this motion was reserved for a future occasion.

After some discussion of other incidental topics, and the transaction of miscellaneous business, the Institute adjourned, having first adopted, with entire unanimity and cordiality, the following vote of thanks, offered by Mr. TRACY.

Resolved, That the thanks of the Institute are hereby most sincerely presented to our friends in Saugus, who have furnished the various pleasant and comfortable features of this day's entertainment, including Messrs. J. D. Lawrence, A. A. Scott, E. P. Robinson, Everett E. Wilson, Wm. Stocker and Wilbur F. Newhall, for their exertions in our behalf; also, to Mrs. John Armitage, Mrs. Benjamin Parker, Mrs. E. P. Robinson, Mrs. Tyler, Mrs. Follett, and other ladies, for their very kind attentions; also, to the Selectmen of Saugus for the use of the Town Hall, and to all others, who, although not known to us, have helped to make this meeting so agreeable.

FRIDAY, JUNE 12, 1868. — Adjourned Meeting.

President in the chair.

S. Augustus Shatswell, G. B. Hall, N. T. Snell, Eliza G. Cogswell, Sarah A. Lynde, all of Salem, were chosen Resident Members.

MONDAY, JUNE 15, 1868. — Regular Meeting.

President in the chair.

William B. Allen, James R. Chapman and Charles A. Larrabee, of Beverly; Edward A. Lord and L. H. P. Turner, of Danvers; Andrew A. Scott, and James Niven, of Saugus, were duly elected Resident Members.

WEDNESDAY, JULY 1, 1868. — Field Meeting at Essex.

Those members and friends of the Institute from Salem, who attended the meeting went, with a few exceptions, in two parties. One, and that much the largest, left Salem at 8, the other at 11.15 A.M.

The route chosen was by cars to Manchester, and thence by vehicles, four and a half miles, over a pleasant road through the woods to Essex. These woods, famous as they are for former contributions to the herbaria of eminent botanists, tempted the lovers of flora among the pedestrians to turn frequently from the path to gather specimens.

Those who rode directly to the appointed town, set out on their explorations in different directions. Some to visit the antiquarian relics of this old settlement. The old burying ground is a curious place and the visitor will be likely to pause at the tablet which marks the resting place of Rev. John Wise the first minister. There are other stones more than a century old, and one which "perpetuates the singular virtues of Rev. John Cleaveland, who died April 22, 1799, which day completed his seventy-seventh year."

From the belfry of the North Church a fine view may be had, including nearly all parts of the town. The bell in this steeple bears the mark "Revere, Boston, 1797."

The vestry of the First Church, kindly granted by the society, was used as the common rendezvous. At this place a committee of ladies, members of the Institute, took charge of the lunch baskets out of which they spread the usual pic-nic repast, after which the assembled company removed to the North Church to hold the customary meetings for reports and discussions.

At 2.25 P.M., the meeting was called to order by the President. Records of last meeting read. Donations and correspondence announced.

THE PRESIDENT introduced the literary exercises of the meeting by remarking that ten years ago the Institute held a Field Meeting at Essex; a meeting of marked interest, greatly enjoyed by those who participated, and which had left pleasant memories of the hospitality of the Essex people. The history of Essex well repaid examination. It was set off from Ipswich in 1679 as a separate parish and called Chebacco Parish. The setting off of the new parish gave rise to troubles similar to those very generally experienced in those times, when such divisions occurred. Chebacco Parish was incorporated as the town of Essex in 1819. Salem had furnished two ministers to Essex. Theophilus Pickering, son of John and Sarah (Burrill) Pickering, of Salem, a graduate of Harvard College in 1719; in 1725, on account of the sickness of Rev. John Wise, was invited to assist him. He was ordained and settled over the Chebacco Church in October, 1727, and until the year 1742 labored harmoniously among the people. About this time Whitfield's preaching occasioned extensive revivals and church controversies and division, in which Mr. Pickering and his people shared. He died in 1747.

Rev. Robert Crowell, son of Captain Samuel and Lydia Crowell, of

Salem, a graduate of Dartmouth College, in 1811, was settled in Essex in 1814. Among other valuable services rendered to the town he wrote a history of Essex printed in 1853, which his son, Prof. E. P. Crowell of Amherst College, is about to supplement and republish.*

The President remarked that at the previous meeting in Essex, the members of the Institute were much instructed by remarks from Hon. David Choate, who is present on this occasion and could interest us still farther by giving information concerning this town and its inhabitants.

Thus called upon, Mr. CHOATE in thoughtful and sprightly terms addressed the meeting.

He said that in ten years a town ought to have made progress, but he feared their visitors to-day could not see the signs of life and growth they have been wont to notice in many of the towns in Essex County which they had recently visited; they were on the line of railroads, but Essex was too remote from these facilities of communication. Here we should see the same river, the same vessels built and sent to the same market; yet he thought there were some things in their natural history of interest. He believed in the existence of rich deposits of iron from the fact that in certain localities the magnetic needle was more deflected than by the mines considered so valuable at Canaan Mt., in Connecticut. There are also natural paint mines, although at present unwrought.

At the former meeting much was said concerning various specimens belonging to natural history, but he did not remember that anything was said about the people. There was a great deal to be said concerning the early settlers of Essex, then the Agawam or ancient Chebacco district, which the present generation should keep in remembrance. When the records of the last Field Meeting of the Institute were read, he realized that we were doing a good work in keeping fresh and present the useful facts of the past, and in instructing the communities we visited, especially the younger members of them concerning their local history.

Our people have had an opportunity to show their patriotism in the late war, and twenty-four of our citizens gave up their lives in the country's cause. Essex furnished one hundred and ninety-five men for the war, of whom one hundred and forty-three were her own citizens. Most of the twenty-four who gave up their lives were shot down on the battle-field. Since the last Field Meeting here we have had a railroad chartered, this being the third. It was chartered two years ago; and he humorously alluded to a threat he had received

*This book was published in the latter part of the year 1868, with sketches of the soldiers in the war of the rebellion, by Hon. David Choate, 1 vol., 8vo, pages 488. Essex, 1868.

that there should be an injunction to stop the operations, in the name of the Commonwealth, unless a report was made. In the name of the town officers he thanked the Institute for this visit. He said there was a veil between us and the past which he hoped this learned society would help to lift. He eulogized the Rev. John Wise, the first minister, whose resting place was visited with interest, both by politicians and ministers. He said by politicians, because the doctrine of no taxation without representation was first uttered by the man who sleeps in the tomb of John Wise. Mr. Wise took an interest in our young country. The first training in old Chebacco was in 1683, and John Wise was there, and here the military character of old Chebacco began. In this connection he told the story of the Essex boy, who having come across the cubs of a bear was finally pursued by the old bear herself but killed her by thrusting a pine knot into her open mouth — an act which showed the courage to which he had been trained, Mr. Wise having had a large influence in the training.

Mr. Choate also exhibited a copy of an old Genevan bible, printed in 1579, which was brought over by Capt. John Low and has remained in the family ever since. It was translated by Miles Coverdale, aided by John Rogers the martyr, and was printed over sixty years before the first cup of coffee was used in England, and eighty-seven years before the first cup of tea. There have been twelve crowned heads in England, down to Victoria, since the book was printed. He also exhibited a long cane with ivory head and silver mounted, which is said to have been made in 1578, a year before the book was printed. This also had been in the family of Lows, and it derived additional interest from the fact that the venerable Daniel Low had leaned upon it. It bore the inscription, engraved upon the silver, "Owned by the family in England, about 1578;" and above, "D. L., U. S. of America, Mch. 14, 1803."

Mr. George D. Phippen, of Salem, was next introduced, and he described the region of the Essex woods where Dr. Cutler had rambled, led by the scent of the magnolia, as had the learned Oakes, the genial Nichols and Osgood, with whom several of us have made excursions. He then exhibited and described some of the specimens of flowering plants which had been collected, among which were the *Linnæa borealis*, named for the distinguished botanist, Linnæus; *Diervilla Canadensis*, belonging to the same family; *Medeola Virginica*, or cucumber plant; *Viburnum*, several species; *Prinos glabra*, or inkberry; *Cypripedium acaule; Mitchella repens*, or loveberry, having always two blossoms to one fruit; *Lysimachia quadrifolia*, having four leaves around the stem, some varieties having more; *Pyrola rotundifolia*, or round leaved pyrola; several forms of the *Potentilla*, the *Kalmia*, etc. He also exhibited specimens of the holly and heath

families, concluding by speaking of the part which flowers bear in propagating the plant, and of the influence of insects, such as bees, in stirring up and distributing the pollen. If by this partial account of a few specimens he had succeeded in exciting in the minds of some of his young auditors wonder, he hoped they would investigate these subjects still farther, for wonder was only the shadow of the temple of knowledge.

Mr. EDWARD S. MORSE of Salem, described the shellheaps found in this vicinity, and which, in fact, have been found all along the coast away to Labrador. These deposits of clams and oyster shells were very ancient, and are to be taken as among the evidences of art which mark the period when they were deposited. There are but few stone implements found with these shells, and the evidence is that the shellheaps belong to an earlier period than the stone implements. Some of the latter he described, including the gouges. Some of the banks of oyster shells are twelve, fifteen and even twenty feet deep, indicating great antiquity. In Ipswich had been found the bones of the moose, deer, elk, and other animals.

Mr. F. W. PUTNAM of Salem, calling attention to the fact that the shellheaps probably belong to an earlier time than the stone period, said he had paid some attention to the stone period. The stone relics are similar in character even when found in different parts of the world; going to show that capacity is similarly developed everywhere.

He exhibited several specimens which had been presented, including a jasper spear head and a gouge from Mr. NOAH STORY of Essex, and a stone war club from Mr. J. S. DODGE of Beverly, who found it at Lynn. He described the instruments of the ancient Peruvians, and spoke of the way of indicating the uses of these various relics, which is largely a matter of conjecture. A hint concerning the uses of these implements is gained from examining those in use among the South Sea Islanders. The Institute is trying to perfect its collections of these curiosities and he appealed to the Essex people to bring out such specimens as they might have in their garrets or out of the way places. Each specimen will be duly figured, and labelled with the name of the donor. It is important to obtain a large collection of these implements that we might if possible learn from them concerning the migration of tribes. He concluded by calling attention to "The American Naturalist," which has now about two thousand subscribers, but must have one thousand more in order to pay its expenses.

Rev. EDWARD S. ATWOOD of Salem, in response to a call from the chair addressed the meeting, giving some interesting facts about the edition of the old bible which had been exhibited. This Genevan book, though old, is not uncommon. The first two editions of the

bible were in manuscript, and, though some of us may have a poor opinion of cards, it was nevertheless to the first printing of cards that the first printed specimens of the Scriptures were due. He then described the invention of cards with their various characters for the amusement of a French king. These were at first painted, but afterwards, as their use became common, the idea was conceived of printing them from blocks of wood. From this suggestion, detached verses and extracts from the bible were put forth, on yellow paper, in a similar manner, and in this fragmentary way we have the first printed specimens of the bible. This edition before us was printed in Geneva for the use of the English exiles banished there. Christopher Barker was made the sole printer of it. He thus became very rich and was made a Baronet. Mr. Atwood also spoke of the exquisite and clear printing which these ancient books reveal, many of them not being surpassed by the best printing of the present day.

Mr. ALPHEUS HYATT had again sought for polyzoa with but small success. He had found one interesting animal upon a piece of seaweed, which he exhibited in a small phial. It was one of the Tubulifera, a compound animal, originally a single cell; by a budding and branching growth it gains at last a common body, out of which and upon which many animals grow having an individual life. He described the minute anatomy of these animals, calling especial attention to the recently proven fact of the branching of the nervous system from the common origin, through the common body to all the members of the composite animal.

Mr. F. W. PUTNAM exhibited a specimen of stone with a tuft of hair attached, which had been sent in for explanation; and called upon Mr. E. S. Morse to explain it. Mr. MORSE then described the process by which the muscle adheres to the rocks by throwing out minute hairs which it spins itself. These brown hairs on the specimen before us, though having the appearance of being human are not human, but are really formed in this way.

On motion of Mr. CHARLES DAVIS of Beverly, it was

Voted, That the thanks of the Essex Institute be tendered to the committee of the First Parish Church and the committee of the Universalist Church, for the use of their respective houses of worship for our meetings this day. Also to Norman Story, Ed. Lander, Leavitt Burnham, John S. Burnham, Dr. Hall, Daniel W. Bartlett, Grover Dodge, Horace Burnham, Leonard Burnham, Caleb Burnham and others for attentions and hospitalities shown us this day.

SATURDAY, JULY 18, 1868. — Special Meeting.

The President in the chair.

A Special Meeting was held this day, in Plummer Hall, at 3 P.M., to listen to the reading of a memoir, prepared by Hon. CHARLES W.

UPHAM of Salem, at the request of the Institute, on the life and character of its late President, FRANCIS PEABODY.

The services were opened by the President with the following brief remarks:—

We are assembled this afternoon to listen to the reading of a memoir prepared by Hon. Charles W. Upham at the request of the Institute on the life and character of our late President, FRANCIS PEABODY. He was from the beginning a constant friend of this Institution, and for the last two and a half years the president. In his last effort for the cause of science in this community he was only permitted to take a few of the initiatory steps, leaving the furtherance of the plans to be accomplished by the surviving associates in the trust, or by his or their successors.

On occasions of this nature the mind involuntarily runs back into the past and calls to recollection those who have in their day and generation been instrumental in the moulding of the various institutions which have for their objects the amelioration of man.

Some one hundred and ten years since at a meeting of the Monday Evening Club composed of the leading spirits of that day, the Brownes, Pickmans, Ornes, Higginson, Lyndes and Olivers, the plan of organizing the Social Library was matured. Some twenty years later the Philosophical Library was called into existence by Holyoke, Prince, Barnard and Orne of Salem, Willard and Fisher of Beverly, and Cutler of the Hamlet, now Hamilton. Thirty years pass away and we behold Bowditch, Story, Pickering, Silsbee and Putnam, organizing the Athenæum, taking the two libraries above named, as the basis of the new Institution. Ten years later, White, Tucker, Saltonstall, King and Ward are interested in the formation of an historical society, to preserve the rich materials everywhere then abundant to elucidate the history of this section of our good old Commonwealth. Another decade of years pass, Peabody, Webb, Cole, Phillips and Peirson are preparing courses of lectures on literature and science adapted to the popular mind, and hence arose that system of lectures which has been so prevalent throughout the country for the past thirty or forty years and which has been a great auxiliary to the cause of general education. After the lapse of some three or four years Nichols of Danvers, Oakes of Ipswich, Perry of Bradford, Page and Ives of Salem, laid the groundwork for a society of natural history to develop a taste for this study and to extend researches into the various departments of nature.

In this connection let us allude to the labors of Hodges, Lambert, Carpenter, Osgood, Crowninshield, Nichols and others in organizing the East India Marine Society in 1799, and consequent thereupon the forming of the valuable Museum which has had a world renowned reputation, and which, with the scientific collections of this society, is being rearranged in the East India Marine Hall, recently obtained and fitted up with galleries and cases for their reception through the liberality of a son of Essex, whom governments and crowned heads delight to honor.

Some of the above named persons were interested in several of these institutions; thus, for instance, the venerable Dr. Edward Augustus Holyoke was one of the original members of the Social Library in 1760, and at the time of his death in 1829, was president of the Athenæum and also of the Historical Society, having held that office

in both of these institutions from their respective organizations, thus taking an active part in the institutions of this place for a period of seventy years.

These have all passed away, leaving deep traces of their influence upon the institutions of this day, which are modifications of the preceding to conform to the wants and requirements of the age.

Although much has been accomplished, yet we have only entered upon the threshold of the domain of science. More remains to be done before the objects which these pioneers have labored for, can be said to be in a good working condition. This duty is never finished; the more an institution does the wider the vista opens and a greater amount of labor is found necessary to be done, increasing as it progresses in a geometrical ratio. It is a law of nature when any institution or organic object ceases to grow, decay commences and a gradual dissolution follows.

Let all who revere the memory of the departed and desire to have accomplished, or at least greatly advanced, the objects that were dear to them, come forward and extend a helping hand to those who bear the heat and burden of the day. Though dead they yet speak in the recollection of their zeal and energy in all worthy undertakings; truly their good works follow them.

Allow me to introduce Mr. UPHAM, who will give a graphic account of the untiring devotion of our deceased friend to the study of the sciences and their application to the useful arts, and a delineation of his character in the various relations of life.

Mr. UPHAM then proceeded to the delivery of his Memoir.*

Preceding the personal narrative was a very full and interesting exposition of the influences that made the Society, and the subject of the eulogy; what they have been, and brought him into the relation he sustained, as their chosen leader and head.

Glancing briefly at the influence of the presence of persons of marked impressiveness of mental traits among the first settlers, Mr. Upham traced the origin of the Institute directly to the Social Evening Club, designed to promote literature and philosophy, which was in existence in Salem about the middle of the last century, and by which a taste for literature and knowledge, a zeal in the prosecution of scientific studies, was imparted to the community, of which we can distinctly trace the imprints and monuments through all our subsequent history.

Filling up this sketch, with a fulness and accuracy of detail which perhaps no other person in our community is competent to supply, Mr. Upham passed on to the biography of Col. Peabody, dwelling on his strongly marked characteristics, his early love for and acquisitions in science, his agency in establishing and strengthening institutions of learning, and his many-sided attainments and activities.

At the close of the address, Hon. ASAHEL HUNTINGTON expressed

* This Memoir has been printed in the Historical Collections of the Essex Institute, vol. ix.

the grateful appreciation by the audience of its great interest and value, and moved its reference to the appropriate committee of the Institute, for publication. This motion was seconded by Vice President A. C. GOODELL, jr., and unanimously adopted, and the company dispersed without farther formality.

The Trustees of the "Peabody Academy of Science," of which Mr. Peabody was chairman at the time of his decease, met in the forenoon for organization under the Act of the Legislature, and were present at Plummer Hall, in the afternoon, to listen to Mr. Upham's discourse.

WEDNESDAY, JULY 22, 1868. — Field Meeting at Rowley.

The third Field Meeting of the present season was held by the Institute at Rowley.

A dredging party consisting of six officers of the Institute left Salem the morning previous. They were hospitably welcomed and entertained by Messrs. Brookhouse, Ives, Johnson, Kinsman, and Frye, of Salem, at their camp house on Rowley river. This party spent the afternoon and evening of Tuesday in searching the shores and creeks of Rowley river, and in dredging near the mouth of Plum Island river. They continued explorations during the forenoon of Wednesday. The region proved to be, for the most part, too sandy to be very fruitful in specimens.

By the five minutes past eight train on Wednesday morning, members and friends of the Institute, a party numbering about one hundred and fifty persons, left Salem for Rowley; their number was enlarged by some who came by the quarter past eleven, and others who took the one o'clock train from Salem.

The residents at Rowley generously provided for the comfort of their visitors. They furnished carriages free of charge to take all who did not prefer to walk to the appointed rendezvous, a mile and a half distant.

Rev. JOHN PIKE, D.D., met those who arrived by the first train at the Town Hall, and in behalf of his fellow citizens, in a neatly turned address, welcomed the Institute to their town. He at the same time pointed out the various places and objects of interest, and tendered the services of guides who were waiting to lead parties wherever they might wish to go.

Several parties were formed and went in various directions over the town. At the appointed hour all assembled again at the Town Hall to partake of the collation prepared by a committee of ladies from the contents of the numerous baskets. Here substantial additions to the usual plain repast, and the presence of the Rowley Brass Band to en-

tertain the company with fine music, gave still farther proof of the cordial hospitality of the citizens.

After the collation the Institute assembled for their discussions in the Congregational Church. Previous to the opening of the meeting they were cheered with music by the band.

The meeting was called to order by the PRESIDENT at half-past two o'clock.

The records of the last meeting were read by the Secretary. Mr. ALPHEUS HYATT announced the donations to the library. Since the last meeting there had been forty-four donors; among whom deserving a particular notice was Mrs. GEORGE CHOATE of Salem, whose gift of books and pamphlets was large and valuable.

Mr. F. W. PUTNAM announced donations to the cabinets.

The usual announcement of the recent correspondence was deferred until the next meeting.

The PRESIDENT, in a brief introductory address, stated that this was the second Field Meeting held by the Institute at Rowley: the first was held in 1862. He called attention to the antiquity of the town, saying that during the period of early emigration to America, extending from 1620 to 1640, four thousand families, representing about twenty thousand persons, came to these shores. Near the close of this period in 1638 Ezekiel Rogers with sixty families arrived, and in April, 1639, commenced the settlement of Rowley. Among these early settlers were many clergymen and persons of eminent learning, and celebrated scholars. The early boundaries of the town included the sea-coast between Ipswich and Newbury, and extended from the ocean to the Merrimac river, embracing the present towns of Rowley, Georgetown, Boxford, Bradford and Groveland. The streets were from the first laid out so that each house might adjoin or be near to a brook. They remain but little changed to the present time.

In concluding, the President called upon Mr. F. W. PUTNAM to give an account of the specimens secured by the dredging party. Mr. Putnam exhibited specimens of the hydroid form of the jelly fish, and remarked on the law of alternate generation. The egg of this animal, furnished with cilia, moves through the water until it becomes attached to some stone or sea plant, when it commences a growth resembling a thickly branching sea-weed. After a time the branches bud, and these buds develop into minute animals, furnished with cilia and tentacles by which they obtain their necessary food. Having attained to a sufficient development, the Medusa buds sever their connection with the parent growth, and assume an independent life as the well known jelly fish.

He also exhibited a large collection of hermit crabs, sticklebacks, minnows, two species of star-fish, and specimens of polyzoa.

In compliance with a special request, Mr. Putnam discoursed upon the "Greenhead." So numerous are these flies upon the Ipswich and Rowley marshes, so bloodthirsty their disposition, so fierce their onset, so unforseen and overwhelming their attacks, that the citizens of Rowley listened feelingly to a minute description of the green eyes, of the bodily structure, and especially of the lance and blood-sucking tube with which their inveterate foe tortures his victims.

To indicate more exactly its character, Mr. P. spoke of the classification of Dipterous insects, stating that this fly belonged to the same family as the common horse-fly. In reply to a question, Mr. Putnam also spoke of the bot-fly, its method of development in the stomach of the horse, and its effect upon that animal.

He concluded by exhibiting the skull and other parts of an Indian skeleton, presented by Mr. WM. JOHNSON, and with the request that the present or future owners of Indian relics would send them to the cabinets of the Institute.

Mr. ALPHEUS HYATT, continuing the description, commenced by Mr. Putnam, of specimens collected by the dredging party, exhibited some strips of eel-grass upon which were incrustations resembling groups of dots united by delicate white lacework. In the openings of this lacework lived minute animals which were beautiful objects when viewed through the microscope. They are called polyzoa. Although so minute and transparent, yet the whole living process can be seen carried on in them as perfectly as in larger beings. Mr. Hyatt had seen them manifest emotion in the irritation produced when one would interfere with another's comfort. From an enthusiastic description of these microscopic animals, the speaker passed to some general remarks upon the lower forms of animal life, saying that every animal has a head, but in the lower animals this head is generally at the point of its attachment. It is not the seat of the governing power, and has not a high development. Still it is now well established that every animal has a head, or nervous centre. From a study of these lower animals one cannot but be strongly impressed with the unity of design shown by a similar plan of structure in all grades of animal life.

Mr. Hyatt also spoke of the deltas formed by the Merrimac, Ipswich and Rowley rivers, and described the methods by which deltas are formed. The probable depth of vegetable accumulations upon the delta forming the Rowley marshes is about two feet.

Mr. ALLEN W. DODGE having asked whether the clam had undergone any change since it was first known and used by man, Mr. PUTNAM stated that the clamshells in the ancient shellheaps were heavier than those upon clams now living. This, perhaps, indicated a deterioration and a possible future extinction of the clam.

Mr. Phippen introduced Mr. ALBERT C. PERKINS of Lawrence, who, he hoped, would speak for the botanical department.

Mr. Perkins described his visit to Prospect Hill, and exhibited several plants which he had there, and on the way thither, collected, among which were the Azalea or Swamp apple, *Pyrola rotundifolia*, *Lysimachia striata*, Orchis, Lobelia, the high and low Blueberry, etc. He was much impressed with the extensive prospect from this eminence, which partook of the character of a mountain view, revealing the village below, and a picturesque section of surrounding country, which included the hills of Boxford, Topsfield, and Hamilton, and Plum Island and part of Essex. The results of the researches in natural history, he said, were now within the reach of all, and the communities visited were much indebted to the young men, the speakers to-day, for the aid they were rendering in the study of natural history. He commended the work of the Institute and spoke of the "American Naturalist" as a publication of great value.

Mr. GEORGE D. PHIPPEN followed with farther remarks on the plants gathered. He prefaced his description by declaring that the naturalist felt that he had a certain right in every locality, because of the various natural objects which excite his interest and require his examination. The Institute had come to Rowley with that feeling, and acted accordingly. Taking up the plants upon the table he commented on the *Alisma plantago; Thalirum cornuti; Asclepias cornuti*, the fibrous inner bark of which had been tested and prepared for the manufacture of thread and cloth; *Hypericum perfoliatum*, Spiraea, Geum, Pyrola, etc. He closed with some remarks upon the general plan of structure and distinctive characteristics of plants.

Mr. A. C. GOODELL, jr., of Salem, speaking for the Historical Department, said that the Institute greatly enjoyed a visit to such an old historical locality as Rowley. Its ancient burial ground was a place of great interest. Having quoted from Thomas Gray the lines:

> "Beneath those Rugged Elms, that yew trees shade
> Where heaves the turf in many a mouldering heap,
> Each in his narrowed cell forever laid
> The rude forefathers of the hamlet sleep."

The speaker said that our forefathers could hardly be called rude. They were largely men of culture and distinction, having among them many ancient divines and scholars. He mentioned that the remains of Ezekiel Rogers were interred in the Rowley cemetery and eulogized his character.

He read a paper prepared by Mr. MATTHEW A. STICKNEY, of Salem, concerning the descendants of WILLIAM STICKNEY, one of the first settlers of Rowley, who died in 1664.

Mr. Goodell then called upon Rev. Dr. PIKE, of Rowley, to inform the Institute concerning a certain epitaph said to have existed in Rowley Cemetery, which ran as follows:

> "Oh Rowley, Rowley, thou hast sinned sore,
> Thou hast lost thy Deacon Jewett and will never see him—again."

Dr. Pike, in reply, stated that no such epitaph could now be found in the grounds, nor could he find an authentic account of its having existed there. He defended the poetry of Rowley from the slander implied in the ridiculous rendering which some had given, by giving the true rendering of the epitaph as follows:

> "Oh Rowley, Rowley, Rowley, thou hast sinned sore,
> Thou has lost thy Deacon Jewett and will never see him more."

Dr. Pike still farther entertained the audience with accounts of some of the early inhabitants of Rowley, and spoke in complimentary terms of the labors of the Institute.

Hon. ALLEN W. DODGE, of Hamilton, raised the question "Cui bono?" What is the use of these studies of the naturalist? This question he answered in part, but he wished it to receive a more complete illustration. He would like to know what is the use of learning all about these bugs and the ravages of insects if we were not told how to get rid of them. A general knowledge of natural science, he admitted, was useful to public speakers. Some speakers and authors had been guilty of gross mistakes, in selecting illustrations from natural history, for lack of accurate knowledge of the objects to which they referred. He asked the same question concerning the tracing of one's ancestry. He thought we had much better ask what are we ourselves than who are our ancestors.

Mr. F. W. PUTNAM, in reply to Mr. Dodge, remarked that the power of scientific men to arrest the ravages of insects was limited to informing the public as to the best method and the best period in the life of the insect for effecting its destruction. But what is needed is the general adoption and carrying out of the suggestions of the naturalist by the farmers. The failure of a few to do their part, keeps alive a sufficient number of breeders to make the efforts of many, to destroy insects injurious to vegetation, futile. To secure the coöperation of the farmers the legislature must enact the necessary laws and appoint agents to enforce their execution. To show the difficulty of obtaining such legislation he alluded to the fate of a proposition, made by an entomologist to Congress, to suppress the ravages of the Hessian fly, which had destroyed millions of dollars worth of grain, by importing its parasites. The proposal was ridiculed and rejected as an absurdity. On the other hand the French Government had arrested the

destructive work of a species of beetle by offering a few *sous* a quart for the grubs.

Mr. D. B. HAGAR, Principal of the Normal School at Salem, found that the Essex Institute caught speakers as they caught bugs, by pouncing upon them unawares. He added to the illustrations of the uses of scientific studies given by Mr. Dodge. Science was of value aside from its material uses. Whatever brings good thoughts, good emotions, is useful. He believed that to lift the rising generation out of its selfish struggle for money we should encourage the study of the natural sciences. The speaker pleasingly and happily illustrated these thoughts. He contrasted the real enjoyment of the liberally educated mind with the poor pleasure of the avaricious money seeker. He spoke of the happy influence of the Institute. He remembered the time when the Institute members were contemptuously called bug-hunters. This term and the tones in which it had been spoken had given him a poor opinion of the Institute and its work. But a more intimate acquaintance with its doings had brought him to count it an honor to be numbered among these bug-hunters.

Mr. A. C. GOODELL, jr., in reply to remarks previously made by Mr. Dodge, asked that Mr. Dodge would apply the doctrines of stock breeding which he advocated at agricultural meetings, to the human race. Then he must admit that it was of some importance from whom we are descended. This occasioned an amusing discussion, brief and sharp, which the lateness of the hour arrested.

The following vote of thanks, on motion of Mr. CHARLES DAVIS of Beverly, was unanimously adopted: —

Resolved, That the thanks of the Institute be tendered to the citizens of Rowley for the use of the Town Hall, and their most generous and courteous reception of us, notwithstanding we have chosen this busy season of the year for our Field Meeting with them; to the officers of the first Congregational Society for the use of their meeting house; to Rev. John Pike and his thoughtful partner for their assiduous attentions during the day; to Messrs. Benj. H. Smith, John Boynton, A. Boynton, Joseph Hale, William C. Foster, George Kimball, John S. Prime, Moses T. Whitney, Mark R. Jewett, John Richards, Thomas Prime, Edward Smith, and Mrs. Kilham, and Miss Anna Titcomb, who have furnished us with carriages to convey us to and from our place of gathering, and have acted as guides; to Capt. B. H. Smith, Capt. A. M. Hill, M. R. Jewett, John Harris, Frederic Todd, Gorham Smith and wife, Mrs. B. Cressey, Mrs. Blodgett, Mrs. M. R. Jewett, and Mrs. D. B. Prime, who have served us at the table, and provided us with many comforts at our collation; and lastly to the Rowley Band, who have surprised us as much by their fine appearance and excellent music, as by their great kindness in offering their services for this occasion.

Resolved, That this day will be long remembered by us, and is another enduring testimonial to that spirit of brotherhood and goodwill which the Essex Institute ever deems it one of its highest objects to promote among all citizens of the county.

Samuel R. Nichols and Samuel G. Jones, both of Salem, and Richardson Knowland, of Marblehead were elected Resident Members.

THURSDAY, AUGUST 6, 1868. — Field Meeting at Marblehead.

According to the Programme, this meeting, the fourth of the present season, commenced at the Eastern Railroad Station, at 9.15 A.M.; the majority of the members and friends of the Institute who attended the meeting, numbering more than four hundred persons, taking the cars at the above named hour.

Several of the members embarked on the yacht America, at Derby wharf, in the early morn, to collect marine specimens by dredging and grappling. The boat was headed first for the Beverly shore to receive Prof. S. F. Baird of the Smithsonian Institution at Washington, and Rev. Joshua A. Swan from Kennebunk, Me. On the way some eelgrass was picked up, thickly coated with hydroids and bryozoa. The whole number of persons expected being received on board, the morning's work began.

Strickly speaking, this was not a dredging, but a grappling party, on their way to search the kelp-grounds in and around Salem harbor. For this purpose they were furnished with a suitable grapple consisting of an iron bar about fourteen inches long, with a loop of iron on one side, and four groups, each containing four stout iron hooks on the other side. By the iron loop this contrivance is attached to a stout rope, while a heavy iron weight is attached about five feet above the hooks. When thrown overboard the weight drags along the bottom, while the bar comes trailing after, lying upon its side and presenting the points of its hooks to catch whatever lies in its course.

The yacht was sailed over kelp-grounds, the grapple thrown over, and after dragging a short distance was drawn up loaded with the kelp weed. A hungry rush of eager naturalists and soon the hooks were cleared, and each man sat searching the leaves, the stems, and especially the roots of the weed with one eye, while he guarded the material he had appropriated for his personal examination with the other. This latter work was much less effectively and successfully done than the former. Meanwhile the grapple was thrown again. The kelp market soon became glutted. Then a more peaceful and quiet enjoyment of the many fine and beautiful specimens of marine animals took place. The glass jars were rapidly stocked with strange and elegant forms of life, conspicuous among which were brilliantly colored worms with fringed extremities. Thus was kept the promise of the proverb to early birds.

A net was occasionally used to capture some medusæ as they floated by, and beside the more common form (*Aurelia flavidula*), one (*Idyia roseola*) was secured, of oval form, whose pink, radiating tubes, covered with beautiful fringe in constant motion, gave it great beauty.

On landing at Marblehead, about noon, sufficient time remained before the hour for the afternoon discussions to permit of a visit to some Indian shellheaps situated in a grove on the northern shore of the town. With recovered vigor this expedition was entered upon and accomplished with much pleasure but little profit. Those who arrived at Marblehead earlier in the forenoon, rendezvoused at the Town Hall, divided into companies as is customary, and some with, and some without guides, went in various directions to explore the town. One party, with patient and laborious digging examined the shellheaps above mentioned.

Many went to the Neck, crossing in boats, and visited the camps where people from Nashua, Lowell, Worcester and other places are "dwelling in tabernacles," and enjoying the delights of the sea-shore. There are several hundred of these summer residents now on the Neck, and their camps are known by the names of the places whence their occupants came, such as "Nashua Village," "Camp Worcester," etc. A few wooden houses have been erected for the accommodation of summer visitors, but the great majority live for the few weeks of the heated term in canvas tents, and as cold weather approaches they "take up their beds and walk" or ride to their distant and more permanent homes. Some of the land on the Neck appears to be in a high state of cultivation, and the portion leased and improved by Mr. Elias Ham attracted special notice for the excellent vegetables growing thereon. Many interesting Indian relics have been found here, and Mr. Ham presented several valuable specimens to the Institute.

Others of the party went to Fort Sewall, where they were received with polite attention by the officer in charge. The government works were admired for their beauty and for the manifest care still bestowed upon them.

The fine old mansion of Dr. Daniel Gile attracted many visitors, who were permitted by the genial proprietor to inspect the identical room where Vice President Elbridge Gerry first saw the light.

The magnificent geological, mineralogical and archæological collections of Mr. Jas. J. H. Gregory were also visited at his residence.

The excellent Reading-room of Dr. J. Wellman attracted many who desired to book themselves up in the news of the day, and to whom the proprietor sent a kind invitation to give him a call.

A few antiquarians accepted the invitation from Glover Broughton, Esq., the Town Clerk, to inspect the ancient town records. The old deed, conveying "the towne ship of Marble Head" from certain

unpronounceable Indian names to certain English named trustees, dated in 1684, was an object of special interest; the grantors hail of Natick, in the Colony of Massachusetts Bay.

The old Bank building was examined by many of the party, who were interested in the peculiar architecture and decorations of an aristocratic residence of a century ago; even the paper on the walls was imported from England. This structure is supposed to have been built in 1768, for Col. Jeremiah Lee, and, like the Sparhawk and Pepperrell houses at Kittery, is a fine specimen of the palatial mansions of the nabobs of the last century. The venerable cashier, JOHN SPARHAWK, Esq., who occupies a portion of the building, very kindly received the company and politely permitted them to inspect the premises.

The old Burying Hill, and indeed many other places of interest, were not forgotten or neglected by the Institute party.

At one o'clock all gathered at the Town Hall, where a pic-nic collation, arranged from the baskets by a committee of ladies, was quickly transferred from the tables to the hungry mouths of the rovers.

From the Town Hall went all to the Universalist Church, where the customary meeting for reports and disscussions was called to order by the PRESIDENT at half past two o'clock. The records of the last meeting and the correspondence were read by the SECRETARY. Donations to the library were announced by Mr. ALPHEUS HYATT, and donations to the cabinet by Mr. F. W. PUTNAM.

After a brief allusion to a former Field Meeting of the Institute held at this place ten years ago, and to the part which a former pastor of this church, Rev. Stillman Barden,* had taken in the proceedings at that time, the PRESIDENT invited Mr. JAMES J. H. GREGORY of Marblehead, as one well versed in the geology of the region, to impart to the audience the information he had acquired. In response, Mr. Gregory gave a very clear and interesting description of the geology of the town. It is for the most part composed of sienite and greenstone, cut by veins of trap. At the north part of the town the greenstone cuts the sienite; at the south they blend. At the lower part of the town is a rose-quartz, which would make excellent building material. At Burlington, Vt., he had seen a church built of alternate blocks of quartz and limestone, and the effect produced was very pleasing. The solution of the question as to the probable method by which the trap was formed, was contained in a single vein of trap in

*Rev. Mr. BARDEN was an active member of the Institute, a frequent attendant upon these meetings, and a zealous mineralogist and geologist. He died at Rockport, August 7, 1865, to which place he removed in August, 1861. A memoir of Mr. Barden by Rev. Mrs. P. A. HANAFORD is printed in the seventh volume of the *Historical Collections* of the Essex Institute.

the town, in which a block of greenstone was so imbedded as to show that it fell in while the trap was in a molten state. There is a magnificent development of porphyry at the Neck which runs submarine and appears at Tinker's Island, then runs submarine and again emerges at half-way rock. The back of the Neck is porphyry and sienite with greenstone. The latter is here and there washed out so that great chasms are thus produced. He accounted for the crookedness of the streets of the town by stating that they followed the natural valleys. Moreover, nearly all their cellars have been made by blasting. The rock in which they are formed is very hard, so that to save expense houses have been placed where the cellar could be most easily obtained. Their pastures are excellent, and although used through several generations grow better instead of poorer. This is owing to the fact that the nourishment for the vegetation is furnished largely by the disintegration of the stones abounding in them.

Mr. C. M. Tracy of Lynn, described in a very happy style, some of the plants that had been gathered. Among which were the orchis, cleaver, wild bergamot, button-bush, etc. The collection of botanical specimens was very large and Mr. Tracy felt compelled to give place to others before a small portion only had been described.

Mr. Alpheus Hyatt commenced a description of the large number of marine specimens collected from the kelp. Remarking that it is not generally known that we have native sponges, he exhibited a specimen of sponge attached to the root of a kelp weed. He explained the structure, growth and method of development of sponges, saying that they were compound animals, that is, a community of animals, living in a common investing membrane. The utility of the sponges of commerce is owing to the development of horny fibre in this membrane, in the place of calcareous spiculæ which form the framework of our native sponges.

Upon a muscle shell exhibited was a gelatinous spot which proved under the microscope to be a community of animals belonging to the class of Mollusks, and named Ascidians. They are similar in general structure to the clam. A question here being asked concerning the clam, Mr. Hyatt described its anatomical structure. He also passed around in a bottle and described some specimens of the Bryozoa or moss animals, as illustrating the composite animals call Polyzoa.

Mr. George D. Phippen of Salem, continued an account of the plants. On his way to the meeting he had collected the common weeds, and he proceeded to give an interesting account of their introduction and classification. The greater part of them were introduced foreigners, the gypsies of vegetation. A weed had been defined to be "a plant out of place," but a true weed was more than that, being troublesome and useless.

Mr. F. W. PUTNAM continued a description of the marine specimens. He said that Mr. Hyatt had spoken concerning representatives of the Protozoa and Mollusks. Between these two classes is another called the Radiates. Belonging to this class were the star-fishes, the sea-urchins, the brittle stars, and the jelly-fish. The distinctive characteristic of these animals is that the different parts of their structure all radiate from the mouth. After a minute account of their anatomical peculiarities, he gave an interesting description of the various and multitudinous forms of life found on the roots of kelp. He had found, to-day, upon them, representatives of all the classes of the animal kingdom, excepting mammals, birds, reptiles and insects. In concluding he announced the donation to the Institute of an Indian gouge by Mr. R. RAMSDELL.

Mr. GREGORY of Marblehead, in reply to request from the President, gave an account of a valuable collection of Indian relics, numbering upwards of two thousand, made by himself during the last eighteen or twenty years. Marblehead, he believed, was, to the Indians, a manufacturing centre. This was indicated by the number of imperfect and half-formed implements and the numerous chippings of stone found. Here also was an Indian fort, whose identity he considers as thoroughly established. Salem, he said, had appropriated the name of Naumkeag, when it more properly belonged to Marblehead. The Indian name meant "good-fishing ground;" therefore inappropriate to Salem, for when Salem people went "a fishing" they came over to Marblehead.

The PRESIDENT, after brief allusion to the ancient history of the town, announced that the hour for closing the meeting had nearly arrived. Whereupon the following resolution of thanks was unanimously adopted: —

Resolved, That the thanks of the Institute are hereby presented to the Proprietors of the Universalist Church for the use of this place of meeting; to the Sutton Light Infantry for the use of their tables; to the Selectmen for the use of the Town Hall; to Messrs. J. J. H. Gregory, J. P. Haskell, R. Knowland, J. E. Hiler, Mason Harris, William Gilley, jr., John Sparhawk, A. Lackey, Mrs. M. H. Reynolds, and John W. Reynolds, for polite attentions; and to many other citizens of the town for many acts of courtesy to our party during the day.

THURSDAY, SEPTEMBER 3, 1868. — Field Meeting at Topsfield.

The fifth Field Meeting of the present season was held at Topsfield. The number in attendance was large, the Eastern Railroad furnishing an extra train to connect with the regular train over the Danvers and Georgetown road. On the arrival of the party at Topsfield, they assembled at Union Hall under the Methodist Church, where they were

welcomed to the ancient town by Prof. NEHEMIAH CLEAVELAND, who alluded to the characteristics of the place, particularly to some features of its history. He spoke of the Indian name of the place, *Shenewemedy*, and said that its unwritten Indian history was of course almost unknown. There were no mounds or cemeteries giving definite memoranda of what the place was prior to the advent of the white race. No Indian relics had been found, excepting a few rude utensils which are frequently dug up, as stone chisels, hammers, arrowheads, etc., etc.

The first white settlers came here from Salem and Ipswich, the earliest official record bearing date of 1639, when what is now Topsfield was included in Salem Village. In 1642, New Meadows seemed to comprise a portion of Salem Village, and this conflict of boundaries appears to have created a serious dispute, which in witchcraft times had produced the most bitter hatred between the contestants. In the first records of New Meadows it is shown that John Endicott owned 500 acres of land in what is now the western part of Topsfield, and a grandson and two of his sons settled here. Simon Bradstreet owned 500 acres in what is now the eastern part of the town, and one of his descendants is still living on the hill. It was through the influence of Mr. Symonds, who came here from Ipswich, that the name of Topsfield was adopted, from the parish in England whence he came. The town was incorporated in 1650. In 1692, Abigail Hobbs of Topsfield was one of the earliest accusers in the witchcraft prosecutions, her own parents even being among her victims. Mary Esty of Topsfield was arrested and released, and again arrested, convicted and executed. B. W. Crowninshield subsequently occupied the house in which Mary Esty had lived.

Among the old families of Topsfield we find the names of Gould, Perkins, Peabody, Wildes, Porter, Dwinnells, etc., whose large posterity are widely scattered over the country. Mr. Cleaveland claimed that Topsfield was a pleasant town, though not striking. The hills afford interesting views of the ocean, of several mountain peaks and of the surrounding towns. Ipswich river runs through Topsfield, and there are several smaller streams. The "mudsills" of some of the brooks had in former times been a fruitful source of dispute and litigation. Among the ponds, that known as Pritchard's, or recently as Hood's pond, is most worthy of mention.

In 1648, Gov. Endicott discovered copper on his farm, and three attempts have, at different periods, been made to render the working productive, but the yield is not sufficient to be profitable.

Mr. Cleaveland also alluded to some of the old buildings in the town, tracing the ancestry of Joe Smith, of Mormon notoriety, to a house still standing in Topsfield. The house in which Capt. Thos.

Perkins was born was also pointed out. In concluding his remarks, he stated that agriculture was the principal productive industry of the town, although there were several extensive shoe manufactories, a wagon manufactory, etc., all of which enjoyed a reputation for good work.

The company then separated into small parties, and under the direction of kind guides, visited the several localities of interest; many ascended the "Great Hill" and enjoyed the extensive and beautiful views from that eminence; some visited Hood's Pond; some went to the Academy, some to River Hill, the cemeteries, etc., while the great majority at some time during the day called at the old Capen House, which is said to be over two centuries old, and whose proprietor has returned so far as practicable to the original plan and finish of the house throughout; while the farm bequeathed to the Essex Agricultural Society by the late Dr. John G. Treadwell, was not neglected. The farm is now carried on by Mr. A. H. Gould, who, in accordance with the provisions of the Treadwell will, is conducting a series of experiments in practical agriculture.

The Great Hill is well named, its massive dimensions fully justifying the title. Quite a number of the party visited it and toiled up its tedious ascent. From its summit a magnificent panorama of Topsfield and the surrounding country is spread out, the scenery presenting a picturesque combination of village, house dotted hills, woods and isolated settlements. As the eye sweeps the horizon, distant mountains present their cloud-like outlines, while the settlements at Beverly, Wenham and Hamilton, and the white beach at Ipswich are plainly in sight.

The high lands and bald hills of the surrounding towns are conspicuous, the meeting-house at Linebrook parish, within the limits of Ipswich, appearing conspicuously and apparently at the foot of one them. At the foot of Great Hill, on the eastern side, there is quite a little village, and not far from this locality, there are numerous hollows and remains of cellars where it is supposed the original settlers of Topsfield dwelt. This locality is called "the College," because the town officials and like dignitaries, are said to have resided there.

The locality of the copper mine is in the south-west side of the town, near the Danvers and Middleton lines. In July or August, 1839. it was opened, with what was then thought a fair promise of success, both as to the quantity and quality of the metal; but nothing came of the effort, and nothing remains of the mine more valuable than its traditionary reputation. The story which led to the effort to work it in 1839, is substantially this:—Seventy years before, an Englishman, named Bunting, of a scientific turn and solitary habits, while rambling

about, discovered evidences of copper ore, some of which was obtained by excavating. He made known his discovery to the owner of the land and entered into an agreement to work it at his own cost, giving the owner one-sixteenth of what was obtained. A vessel load was dug and shipped to England, but Bunting, who accompanied it, was taken sick and died, and no one knew what became of the ore. In process of time the affair was forgotten except by one or two of the "oldest inhabitants." Subsequently one of Bunting's descendants, finding the old agreement of his ancestor concerning the ore, and thinking there might be wealth in store, came to the "Province of Massachusetts, North America," and found an old man in Topsfield who remembered the affair. There is no record, however, that the young Englishman saw a prospect sufficiently flattering to attempt to work the mine. But this tradition is supposed to be at the bottom of the attempt to work it thirty years ago.

The Capen House is one of the old houses alluded to by Mr. Cleaveland. It is situated close to the meeting-house, and was consequently visited by a large number of the party. Mr. CHARLES H. HOLMES, the owner and occupant, was quite attentive in showing the visitors around and pointing out the peculiarities of the old place, which is now not far from two hundred years old. It is supposed to have been a garrison house in the days of Indian troubles, and, though not built by him, was soon owned by Mr. Capen, a minister of the place for a period of forty-two years. The house has been in the Emerson family, with which Mr. Holmes is connected, for upwards of one hundred and fifty years. It possesses all the peculiarities of the structures of the early period, and the visitors, when they contemplated the fact that the entire stud of the first story was required to accommodate Mr. Holmes from head to toe, were unanimous in the opinion that the original builders must have been unmindful of the dimensions that would require shelter under its roof two centuries afterwards.

Topsfield, as Mr. Cleaveland remarked in the morning, has three burying grounds; one of which, the cemetery on the Georgetown road, was visited. Here lie buried three of the old ministers of the town, Capen, Emerson and Huntington. To the Rev. Asahel Huntington a granite monument is erected, on which are inscribed the names of other deceased members of the family. Here too, repose the remains of Thomas Perkins, the eminent Salem merchant, who was associated with the late Joseph Peabody, and who bequeathed the Franklin Building to the Salem Marine Society. His modest tombstone bears this inscription:

In memory of THOMAS PERKINS, Esq., an eminent merchant. His industry, temperance and enterprise raised him from poverty to immense wealth, which he enjoyed without pride or ostentation, and dispensed with justice and benevolence. He was diligent and faithful in business, pure in his life and conversation; of a sound and vigorous mind, and of an integrity and fortitude which neither pros-

perity or adversity could shake or corrupt. He was an affectionate son, a kind relative, and a firm friend. He was a Christian above sectarian prejudice, and a man above fear and without reproach. He was born in Topsfield, April 2, 1758, and died Nov. 24, 1830."

The inscription which denotes the resting place of the remains of Rev. Joseph Capen, who owned the old house above referred to, reads thus: —

"Here lyes Buried the Body of the Reverend Mr. Joseph Capen A Faithful Minister of Christ who liued an ordained Pastor of ye Church in Topsfield 42 years & Departed this Life ye last day of June 1725, aged 66 years.
Dear Mr. Capen that reuered man, who did the Faith of Christ maintain. A Learned Man and Godly too. None will Denie this who him knew."

Mrs. Capen, his wife, is thus commemorated: —

"Here lies Buried the Body of Mrs. Priscilla, ye wife of ye Rev. Joseph Capen, who died Oct. 18th, 1743, in the 86th year of her age."

If the poetry of Mr. Capen's inscription is of doubtful excellence, it is not more striking, in this respect, than the following effort to immortalize Mr. David Balch: —

MEMENTO MORI.

"This monument, as a mark of filial respect, is raised to the remembrance of DAVID BALCH, who bid adieu to the delusive and transitory scenes of this world on the 22 of July, 1812, Æ. 59. Whose last dying words were, 'To the war.'

'Non ille pro caris amicis
Ant patria timidus perire.'
Sweet Jesus was resigned to the
Father's will,
Indeed so was he who lies here still."

Mr. Balch died by suicide. In the Latin inscription above given, his eulogist aimed to convey to the world the idea that he was not afraid to die either for his dear friends or his country.

Another queer inscription is that upon a stone erected by Amos Lefavor, of a family of scattered Acadians, to the memory of Mary Lefavor, who died May 28, 1797, aged 74. It runs thus: —

"Reader pass on, ne'er waste your time
On bad biography and bitter rhyme;
For what I am, this cumbrous clay ensures,
And what I was, is no affair of yours."

There are many other things of interest connected with this town which might be named if our limits served.

With all the attractions and associations of the place, and the kind attentions of the citizens, the party found no difficulty in deriving pleasures from their rambles and knowledge of their good country neighbors, who, at the collation, which took place at one o'clock in the basement of the Methodist Church, spared no efforts to promote the substantial comfort of the guests, furnishing delicious tea and coffee as well as more substantial elements, in addition to the contents of the baskets carried by the visitors.

At 2 o'clock, the meeting for reports, discussions and speaking was held at the Methodist Church, which was crowded with an attentive audience; many people of the town were present to listen to the ex-

ercises. The PRESIDENT in the chair, and in the absence of the Secretary Mr. PUTNAM was appointed to the place; the record of the preceding meeting was read; the donations to the library and cabinets since the last report, and the correspondence, were announced by the proper officers.

The PRESIDENT in opening the meeting made a few remarks, alluding to this place as the geographical centre of the county and before the introduction of railroads very often selected for the assembling of conventions of various kinds, political, educational, religious, etc. The Agricultural Society held its first cattle show in this town in 1820, when Dr. Andrew Nichols of Danvers delivered the address; an important meeting for organizing Lyceums in this county was held in 1829, when the Hon. D. A. White delivered a very valuable and instructive lecture; the meeting for the completion of the organziation of the Essex County Natural History Society, incorporated in 1848 with the Essex Historical Society, under the name of the Essex Institute, was held in April, 1834. The first Field Meeting of the Institute, under its present system, was held in the Academy building in June, 1856, another meeting was held in 1860, and this is the fourth time that the society has assembled in this place.

Mr. SAMUEL P. FOWLER, who was present at the first meeting, was called upon and gave a very interesting account of that first gathering of a few devoted friends of natural history, including Dr. A. Nichols of Danvers, Wm. Oakes of Ipswich, Rev. G. B. Perry of Bradford, B. H. Ives of Salem, and others, who have long since been gathered to their fathers; and contrasted that day of small things with the meetings of the present time.

Mr. F. W. PUTNAM described his experience while on his way to the pond, having picked up some zoölogical specimens under the fallen trunk of an old pine tree, consisting of spiders, two or three species of centipedes, including the common earwigs, and crustaceans represented by the sow-bug and pill-bug, and specimens of several kinds of snails. Three species of salamanders were also collected under the log. On turning over a stone, a tree-toad jumped forth. This animal, which he exhibited to the audience, will change its color, like the chameleon, and has the power of walking up a pane of glass as easily as a fly. Mr. Putnam described the large yellow spider, of which he had several specimens, which has the habit, on the approach of an intruder, of making its web vibrate so rapidly as hardly to be seen. He also explained the structure of spiders generally, and compared them with other insects, and described the interesting process by which they spin their thread. He likewise spoke of the beetles found on the potato vines here, which are not, as has been feared, the much dreaded Colorado potato bug. He also exhibited a collection

of Indian implements that had been presented, and spoke of their peculiarities and probable uses.

Among the specimens presented to the Institute, were a small stone gouge from J. W. BATCHELDER; club-stone, gouge and small axe, from J. ARTHUR LAMSON; a large stone gouge, from Z. GOULD. These were all found in Topsfield where the donors reside. Dr. Charles Palmer presented from GEORGE CALDWELL of Ipswich, seven stone implements, among them a singular and unique implement, and a fine corn-smasher and peculiar form of a small gouge. EBEN H. LAKE of Topsfield, placed several stone implements on the table for exhibition.

Mr. NEHEMIAH CLEAVELAND, during Mr. Putnam's remarks, asked whether the common house adder was a venomous reptile; to which the latter replied that the rattlesnake was the only venomous snake found in this locality. He was aware that the house adder and the water adder were called venomous, and it is true they will show fight and bite on provocation; but they are not provided with poison fangs and their bite is harmless.

Mr. ALPHEUS HYATT spoke of the felspar, quartz, and mica which composed the rocks of Salem and vicinity, and alluding to the mass of disintegrated rock near by, inferred, from its northwest dip, that it was a rock in place and was not transported there as had been supposed, by glaciers during the drift period. He thought this rotten rock might be occasioned by the presence of iron, the rust of which has a disintegrating effect. He said we know nothing, comparatively, of the geology of New England compared with that of the states west of the Hudson, and explained the glacial theory, in tracing the cause of the formation of gravel beds.

In describing his collection of animals at the pond, he spoke of the Polyzoa, or moss animals, which inhabited the surface of floating boards and the stems of the lilies. He also described the club moss, in its geological relations as a representative of ancient life.

In answer to a question, Mr. Hyatt illustrated on the blackboard the process of the formation of the North American continent.

The PRESIDENT, after alluding to his faithful and arduous services as Adjutant General of the state, introduced Gen. WILLIAM SCHOULER of Lynn, who responded by saying that he had been interested and instructed at what he heard and would gladly listen to others, being ignorant of science, and the subjects treated of being so different from his customary pursuits, he would be unable to edify the meeting. It was his first visit to Topsfield, and his first meeting with the Institute, but he trusted that it would not be the last. He expressed the interest he had felt in listening to the remarks of the previous speakers, his appreciation of the beautiful town and his gratification

at the warm reception and kind attention extended by the citizens. These meetings were fraught with valuable information, and he hoped they would long continue to exert their salutary influence.

The venerable Dr. J. SPOFFORD of Groveland, gave some interesting reminiscences from his own recollections of the earlier history of Topsfield and vicinity, and alluded to the Capen house which had attracted so much attention during the former part of the day. He then gave a genealogical history of the Capen family, and a description of the house occupied by them, now some two hundred years old, and named some of its occupants who had become somewhat famous in local history. He said that he was somewhat puzzled to know why they built the second story with a projection, and also with a higher stud than the lower.

Mr. CHARLES H. HOLMES explained the projection as being the style of architecture prevailing in Holland, whence the builders of this house emigrated, and said that it was out of respect to their Dutch proclivities that they introduced the practice here.

Dr. SPOFFORD thought that explanation might do pretty well, but he wanted to know why the Dutch built in that style.

Mr. WILLIAM B. TRASK of Dorchester, editor of the "Genealogical Register," read the inscription on the tombstone of Rev. Mr. Capen for whom the Capen house is named, and gave an historical sketch of the Capen family, and traced its connection with an ancient Dorchester family of that name.

Mr. SAMUEL TODD of Tospfield, differed from Mr. Hyatt in his opinion (expressed during the early part of the meeting) that the disintegrated rock was an original bed. He had had much experience among the rocks in this vicinity, and said one could not dig anywhere in the village deeper than from nine to twelve feet without getting water. This, with the fact that he had taken sand from under parts of this bed, led him to believe that this rock was deposited here, and that the drift period was the agency that formed the town of Topsfield.

Mr. HYATT complimented Mr. Todd, by saying he wished the Institute could meet with more of such men at their meetings, and also remarked that it was rare to find so many men as they had met with here, well versed in geology. Nevertheless, he was confident that Mr. Todd was in error in his supposition that this mass drifted hither, and adhered to his proposition that this rock, in its general formation, conformed to every rule which marked the fixed rocks of adjacent localities.

The subject was continued briefly, by Mr. NEHEMIAH CLEAVELAND, who coincided with the views advanced by Mr. Hyatt regarding the character of the rock.

Rev. Mr. BRIDGE of Topsfield, expressed the gratification afforded to himself and the citizens of the town at the visit of the Institute.

On motion of Mr. SAMUEL P. FOWLER of Danvers, the following vote was passed:—

Whereas, in view of the almost total lack of interest felt in the preservation of ancient buildings;

Resolved, That the thanks of the Institute are due to Mr. Charles H. Holmes for so well preserving the "Capen house";

Resolved, That the Institute will do all in its power to build up a public sentiment in this direction.

On motion of Mr. T. M. STIMPSON of Peabody, warmly seconded by Mr. E. N. WALTON of Salem, the following resolution was unanimously adopted:—

Resolved, That the thanks of the Essex Institute be presented to Messrs. Richard Phillips, jr., Nehemiah Cleaveland, B. P. Adams, Ezra Towne and Chas. J. Peabody; Mrs. A. H. Gould, Mrs. Jacob Foster, Mrs. Samuel Adams, Mrs. Richard Ward, Mrs. T. K. Leach, Mrs. Richard Phillips, Miss Abbie Cleaveland and other friends who have contributed to render this meeting so interesting and profitable. Also to the Methodist Society for the use of their church.

The meeting then adjourned to Friday.

FRIDAY, SEPTEMBER 4, 1868. — Adjourned Meeting.

The PRESIDENT in the chair.

Mrs. Bradstreet Cressy of Rowley; Benjamin R. Allen, Wm. W. G. Haskell, William B. Brown and James J. H. Gregory, all of Marblehead, were duly elected Resident Members.

MONDAY, SEPTEMBER 7, 1868. — Regular Meeting.

The PRESIDENT in the chair.

Adjourned to Tuesday, September 8.

TUESDAY, SEPTEMBER 8, 1868. — Adjourned Meeting.

The PRESIDENT in the chair.

Charles Palmer of Ipswich, Samuel Preston and Harriet W. Preston of Danvers, Joseph Kidder of Salem, and James B. Batchelder of Marblehead, were duly elected Resident Members.

MONDAY, OCTOBER 19, 1868. — Regular Meeting.

The PRESIDENT in the chair.

A committee was appointed, consisting of Henry M. Brooks, W. P. Upham, George Perkins and John Robinson to confer with a committee of the Trustees of the Peabody Academy of Science, relative to

receiving on deposit by the Institute, Historical Specimens, Books, Pamphlets, etc., in the custody of the Peabody Academy of Science.

WEDNESDAY, NOVEMBER 11, 1868. — Quarterly Meeting.

The PRESIDENT in the chair.

Voted, That a committee of ten persons, consisting of the President, 1st Vice President and Secretary, together with Messrs. F. W. Putnam, R. S. Rantoul, W. P. Upham, E. H. Quimby, A. Hyatt, G. D. Phippen, and James Kimball, be hereby appointed to publish a Guide to Salem if they may deem it expedient, with full powers to add to their numbers as may seem to them necessary.

Dr. A. S. PACKARD, jr., in compliance with a request made at a previous committee meeting, proposed a plan for an Annual Report on the Progress of Entomology in America.

On motion of Mr. PUTNAM: — *Voted*, to recommend the substitution of the word *three*, or the word *five*, before the word dollars, for the word *two*, in article seven of the Constitution.

The following Amendment to the Constitution was adopted: —

Article II. Substitute for the word "Secretary" the following words, — A Recording and Home Secretary and a Foreign Secretary.

James T. Hewes of Salem, was elected a Resident Member.

MONDAY, NOVEMBER 16, 1868. — Regular Evening Meeting.

The PRESIDENT in the chair.

Records of last meeting read; correspondence and donations announced.

The PRESIDENT announced that tidings had been received of the death of Mr. HORACE MANN of Cambridge, a gentleman well known to many of the members of the Institute as the acceptable and instructive lecturer on Botany before the Institute during the past spring.

Mr. F. W. PUTNAM stated that Mr. Mann died on Wednesday last. He was an accomplished and rising botanist. He was appointed as the substitute of Prof. Gray, in Harvard University, during the Professor's absence in Europe. About two years since he visited the Hawaiian Islands and collected a vast amount of material, illustrative of the Flora of those Islands, which he was preparing for publication, a portion having already appeared in the Proceedings of the Institute.

Mr. Putnam read the following resolutions, which were adopted:

Resolved, That the members of the Essex Institute most deeply sympathize with the family and friends of their late associate, HORACE MANN, whose sudden death not only casts a deep sorrow on the hearts of those who were near and dear to him, but also into the scientific

bodies with which he was connected, and deprives his loved science of botany of one of its most devoted and conscientious investigators, and of one, who, had it been permitted, would, from his purity and depth of thought, undoubtedly have made one of the leading botanists of his generation.

Resolved, That the Secretary be requested to transmit a copy of these resolutions to the family of our late associate, and to tender to them our condolence and sympathy in this bereavement.

Mr. ALPHEUS HYATT feelingly alluded to the great loss which had been sustained in the death of Mr. Mann and proposed the following resolution, which was adopted:

Resolved, That Dr. A. S. Packard, jr.,* be requested to prepare a memoir of Mr. Mann to be inserted in the Proceedings of the Institute.

Dr. GEORGE B. LORING stated that he had known Mr. Mann as a boy. We are apt to pass boys, but this boy arrested his attention. When lecturing in Salem last winter Mr. Mann had been the speaker's guest. He was then struck with his accuracy of information; his wisdom of thought and propriety of expression. He partook eminently of the nature of a scholar. He had come to us as the result of the training of his father and the educational institutions of this Commonwealth.

Mr. PUTNAM announced the recent decease of two other botanists, corresponding members of the Institute, W. W. DENSLOW of New York, better known as a collector than as an investigator; and the Rev. JAMES HUBBERT of St. Francis College, Canada, who prepared a "Catalogue of Canadian plants." Both were enthusiastic workers for, and correspondents of the Institute.

The PRESIDENT exhibited a blotter, a donation from Dr. Samuel A. Green of Boston, and read an extract from the "Boston Traveller," which gave an account of a tornado by which this book with other articles were carried many miles through the air.

Mr. A. HYATT gave an interesting account of his observation of the Meteoric Shower of Nov. 13, and mentioned many interesting speculations to which the Meteoric Phenomena had given rise in the ancient and modern efforts to explain the nature and course of their bodies.

A discussion followed, participated in by Mr. G. D. PHIPPEN, Dr. G. B. LORING and others.

MONDAY, DECEMBER 7, 1868. — Regular Evening Meeting.
The PRESIDENT in the chair.

Records of last meeting read; correspondence and donations announced. [The violence of a storm had so interfered with the as-

*Another friend of Mr. Mann's has prepared a memoir, in place of Dr. Packard, which has been printed in the "Bulletin of the Essex Institute," Vol. i, Nos. 2 and 3.

sembling of the members that the reading of the communications were deferred to the next meeting.]

MONDAY, DECEMBER 21, 1868.—Regular Evening Meeting.

The PRESIDENT in the chair.

Records read and correspondence and donations announced.

The PRESIDENT stated that during the past season he, in company with a friend, had visited the American Antiquarian Society's Hall at Worcester, and by the politeness of the officers in charge, had the privilege of examining the journals and other papers kept by the late Rev. Dr. Bentley. These manuscripts comprise about twenty closely written volumes, containing an account of the leading events which occurred in Salem during the time of Dr. Bentley. He read several extracts from them, exhibiting somewhat the fulness with which the leading events in Salem during the period of his pastorate were described. This period covered a very important era in the history of Salem, from 1783 to 1819.

Hon. J. G. WATERS narrated, in a very happy and graphic manner, many facts illustrative of the life, character and writings of the celebrated Dr. Bentley, whose name is held in great respect by all his old parishioners and their families, and who has an extensive reputation as a scholar and a theologian.

Mr. F. W. PUTNAM exhibited a stone pan and roller which were used by the natives in Central America to mash the corn. This was obtained by Mr. McNeil, who has recently returned from an expedition into that country, bringing a large and very valuable collection of specimens illustrative of its natural history and its archæology, forming a valuable addition to the Museum of the Peabody Academy of Science. Mr. P. made some interesting remarks in relation to this subject, and called the attention of the meeting to the important results of these investigations by Mr. McNeil.

LIST OF LETTERS RECEIVED

DURING THE YEAR 1868.

Agnew, Samuel, Philadelphia, Pa., Feb. 15; Akhurst, John, Brooklyn, N. Y., Apr. 18; Akklimatisations Verein in Berlin, Feb. 18; Allen, Anson, Orono, Me., Feb. 5; American Entomological Society, Feb. 1; Anthropological Society of London, Mar. 18; Atkins, Charles G., Augusta, Me., Dec. 24, 30, Feb. 28, Mar. 28, Apr. 3, May 15; Atkins, E.J., Augusta, Me., May 16; Atwood, N. E., Provincetown, Mar. 10, Boston, Mar. 16; Baird, S. F., Smithsonian Institution, Dec. 26, 28, May 20, June 22; Baker, Francis, South Danvers, Jan. 29; Banvard, Joseph, Paterson, N. J., Dec. 28; Barnard, Henry, Hartford, Conn., Dec. 25, 28, Jan. 1, 23, 27, Feb. 5, 26, Mar. 6; Bartlett, John, Haverhill, Apr. 27; Bell, S. D., Manchester, N. H., Apr. 30; Bertram, John, Salem, May 23; Bibliotheca Universitatis, Lugduno Batavæ, Oct. 22; Binney, W. G., Burlington, N. J., Mar. 18; Blake, W. P., New Haven, Conn., Jan. 27; Boardman, Samuel L., Augusta, Me., Feb. 5; Boll, Dr. E., Mecklenburg, Sept. 26; Bolles, Rev. E. C., Portland, Me., Jan. 2, 4, 10, Feb. 15, 22, Mar. 2, 3, Apr. 2, 3; Boston Society of Natural History, Mar. 27; Bosworth, Mrs. G. W., Lawrence, May 27; Breed, Dr. Mary E., Lynn, June 4; Brewster, C. G., Boston, Jan. 3; Brown, E. N., Boston, May 20; Brown, N., Boston, May 21; Brown, S. A., Salem, June 10; Buffalo Historical Society, Mar. 11; Burnham, W., Essex, Apr. 21; Bushnell, Charles J., New York, May 19; Buswell, E. W., Boston, May 5, 7; California Academy of Science, Jan. 13, 18; Challen, Howard, Philadelphia, Pa., Feb. 7; Mar., May 18; Chase, J. E., Holyoke, Jan. 23; Chicago Academy of Science, Feb. 28; Cloutman, W. R., Charleston, S. C., July 11; Codman & Shurtleff, Boston, Feb. 18; Cogswell, Miss E. G., Salem, June 23; Colburn, J., Boston, June 13; Colles, J. A. Purefoy, Officiating Curator of the Indian Museum, Calcutta, Apr. 16; Cook, Henry, Boston, Mar. 16; Cope, Prof. E. D., Philadelphia, Pa., May 29; Corporation of Yale College, Mar. 11; Coues, Dr. Elliott, Columbia, S. C., Apr. 3, 14, May 27, 28, June 1; Cowles, John, P., Ipswich, Mar. 17; Crosse, H., Paris, Sept. 1; Davis, Henry, McGregor, Iowa, Dec. 20, Feb. 6, May 26; Dawson, Henry B., Morrisania, N. Y., Dec. 27; Denslow, W. W., Inwood, N. Y., Feb. 11, 27; Die Gesellschaft Naturforschender Freunde zu Berlin, Feb. 7; Die Konigliche Gesellschaft der Wissenschaften zu Gottingen, Oct. 10; Die Naturhistoriche Gesellschaft zu Hanover, Feb. 2; Dinwiddie, Robert, New York, June 1; Eaton, W. Winslow, Danvers, Jan. 20; Edwards, A. M., New York. Apr. 20; Faxon, Walter, Cambridge, Mar. 5; Felt, C. W., Salem, Jan. 24; Felt, John, Salem, May 12; Fowler, James, Richibucto, N. B., May 21, 29; Garrison, W. P., New York, May 27; Gilbert, G. K., Rochester, N. Y., Dec. 28; Gillis, J. A., Salem, May 15; Goodell, A. C., jr., Salem, Dec. 28, Feb. 4, May 15, 24; Gould, J. J., Wenham, Apr. 13; Green, Dr. S. A., Boston, Mar. 28; Hall, Prof. J., Albany, N. Y., Apr. 14, 16; Hanaford, Mrs. P. A., Reading, Mar. 17; Hart, Charles H., Philadelphia, Pa., Dec. 31; Hartt, C. Fred., New York, Feb. 1; Haskell, J. P., Marblehead, Aug. 3; Henry, Prof. Joseph, Smithsonian Institution, May 2, June 1, 13; Higbee, Charles H., Salem, June 8; Higginson, T. W., Newport, R. I., Jan. 3; Holden, N. J., Salem, Aug. 5; Holland, A., Boston, Mar. 9; Holmes, John C., Ypsilanti, Mich., Feb. 6; How, Moses, Haverhill, Mar. 16; Howard, C. J., Mount Vernon, N. Y., Feb. 10; Howard, Winslow, J., West Swansey, N. H., Jan. 29; Howland, William, Lynn, Jan. 18; Hughes, D. Darwin, Marshall, Mich., Jan. 30; Institut National Genevois, Geneve, Nov. 17; Iowa, Sec'y of the State of, Des Moines, Iowa, June 23; Iowa State Historical Society, Iowa City, Apr. 13; Jeffries, B. J., Boston, Apr. 13; Jefferis, W. W., West Chester, Pa., Feb. 3; Jillson, S., Hudson, Apr. 13; Johnson, D. C., Newburyport, May 11; Kaiserliche Akademie

der Wissenschaften in Wien, Nov. 12; Konigliche Kaiserliche Zoologisch botanische Gesellschaft, Wien Nov. 29; Konigliche Bayerische botanische Gesellschaft, Regensburg, Sept. 28; Lackey, A., Marblehead, Apr. 9; Atkinson, May 27; Lander, W. W., Salem, Aug. 3; Lea, Isaac, Philadelphia, Pa., May 7; Lewis, E. A. Batavia, N. Y., Feb. 4; Lord, Melvin, Boston, Dec. 27; Loring, Francis W., Boston, Feb. 29; Lowry, W., New York, May 21, 27; Lyceum of Natural History, New York, May 19, 20; Lynde, Miss Sarah A., Salem, June 22; Maine Historical Society, Feb., Mar.; Mann, Horace, Cambridge, Jan. 22; Manning, J. A., Salem, Apr. 2; Marsh, O. C., New Haven, Conn., Dec. 30, Feb. 12; Massachusetts Historical Society, Boston, Apr. 15; Massachusetts Institute of Technology, Boston, Jan. 27, May 20; McCoy, John F., New York, Mar. 3; Mead, S. B., Augusta, Ill., Apr. 10; Medical and Surgical Reporter, Philadelphia, Pa., May 5, June 20; Mercantile Library Association, Secretary of, New York, June 17; Miller, George D., Riverdale, N. Y., June 3; Milroy, John F., New York, May, 11; Minnesota Historical Society, Mar. 8; Moravian Society, Nazareth, Pa., May 6; Nation, New York, May 26; New Bedford Public Library, Feb. 3; New England Historic Genealogical Society, Mar. 10; New Jersey Historical Society, Mar. 15; New York State Library, Albany, Mar. 30; Nichols, Samuel R., Salem, July 28; Niven, James, Saugus, June; Norton, E., Farmington, Feb. 8; Noyes, Amos, Newburyport, Mar. 20; Oliver, J. E., Lynn, Mar. 26; Ordway, Albert, Richmond, Va., Apr. 18; Orton, James, Rochester, N. Y., May 1, 19; Osborn, C. S., Suspension Bridge, N. Y., Apr. 11; Peabody, S. E., Salem, May 15; Peirson, Jonathan, Schenectady, N. Y.. May 12; Perkins, Benj. C., Salem, Jan. 16; Perkins, Henry C., Newburyport, Jan. 16, May 15; Phillips, R. jr., Topsfield, July 13; Phippen, George D., Salem, May 16; Poey, Felipe, Havana, Cuba, Apr. 6; Poole, Isaac A., Chicago, Ill., Feb. 7, June 23; Preston, C. P., Danvers, Jan. 13, June 11; Putnam, W. E., Danvers, Jan. 2; Rantoul, R. S., Salem, Mar. 23; Reakirt, Tryon, Philadelphia, Pa., Apr. 4; Redwood Library, Librarian of, Newport, R. I., June 27; Reilly, P. T. O., Worcester, Feb. 8; Rice, Henry B., Boston, Oct. 16; Rice, Joseph W., Providence, R. I., Mar. 6; Richards, T. T., St. Louis, Mo., Apr. 10; Robinson, C., New York, Feb. 27; Robinson, John, Salem, Jan. 29; Rogers, William, B., Boston, Dec. 28; Royal Academy, Munich, Mar. 31; Rue, Charles B., Danvers, Jan. 17; Ruyner, H. M., New York, Jan. 31; Salisbury, J. H., Cleveland, O., Feb. 10; Sampson, Davenport & Co., Boston, Mar. 3; Sampson, George, Boston, Apr. 16; Scott, Andrew H., Saugus, June; Scudder, S. H., Boston, Mar. 10, 13; Secretary of State for Canada, Ottawa, Mar. 2; Shatswell, J. Augustus, Salem, June; Smith, Edward A., Jan. 20; Smith, Lizzie H., Salem, Mar. 30; Smith, Samuel H., Salem, Feb. 11; Smithsonian Institution, Dec. 11, Feb. 4, Apr. 18, May 18, 19; Snelling, S. G., Boston, July 10; Sociéte Imperial des Naturalistes de Moscou, Nov. 4, 16; Society of Antiquaries of London, Nov. 25; Spooner, Thos., Reading, O., Jan. 20; Stimpson, Wm., Chicago, Ill., Mar. 13, 14; Stone, Edwin M., Providence, R. I., Aug. 4; Story, Norman, Essex, June 22; Swallow, G. C., Columbia, Mo., Jan. 6; Tellkampf, T. A., New York, Feb. 8; Tenny, S., Poughkeepsie, N. Y., Apr. 3; Tracy, C. M., Lynn, Jan. 29; Treadwell, E. W., Boston, Apr. 12, May 21; True, N. T., Bethel, Me., Jan. 7; Upton, Lucy H., Salem, Jan. 30; Veatch, Charles, Keytesville, Mo., Dec. 25; Venable, Edward, Paducah, Ky., Apr. 20; Victor Meunier, Paris, France, Oct. 29; Vose, George L., Paris, Me., Apr. 13; Wassell, J., Newburyport, May 12; Waters, J. Linton, Chicago, Ill., July 9, 31; Watt, David A. P., Montreal, Canada, Apr. 4. June 26; Wheeler, E, S., Savannah, Ga., Apr. 17, Berlin, N. Y., May 11; White, C. A., Iowa City, June 3; White, W. O., Keene, N. H., Mar. 18, 23; Whitmore, W. H., Boston, Jan. 25; Williams, Chauncy K., Rutland, Vt.; Wilson, John & Son, Cambridge, Jan. 2; Wood, Dr. H. C., Philadelphia, Pa., June 19; Woods, Thomas N., Rockport, June 10.

ADDITIONS TO THE LIBRARY FOR THE YEAR 1868.

BY DONATION.

AGASSIZ, Prof. LOUIS, of Cambridge. Illustrated Catalogue of the Museum of Comparative Zoölogy at Harvard College, Imp. 8vo. Cambridge, 1865.

ALMY, JAMES F., of Salem. Hymns for the Sanctuary, 1 vol. 8vo. Salem Directory and Almanac for 1850, 1 vol. 12mo, Salem. Boston Almanac for 1851, 1 vol. 12mo, Boston. Miscellaneous pamphlets, 7.

ANTIOCH COLLEGE. Catalogue of Officers and Students for 1867-68, 8vo. Yellow Springs, 1868.

APPLETON, WILLIAM F., of Boston. Memorial of the Cranes at Chilton, sm. 4to. Cambridge, 1868.

BAIRD, Prof. SPENCER F., of Washington, D. C. Discussion of the West India Cyclone, Oct. 29, 30, 1867, 8vo, pamph. Washington, 1868.

BAKER, NATHANIEL B., Adj. Gen. of the State of Iowa. Report of the Adjutant General of the State of Iowa, for the years 1863 to 1868, 8vo, 8 vols. Des Moines, 1863-1868.

BARNARD, HENRY, of Washington, D. C. Report of the Committee of the Department of Education, for 1867-68, 1 vol. 8vo. Washington, 1868.

BARNARD, JAMES M., of Boston. Murray's Hand Book for Travellers in the East, 1 vol. 16mo. London, 1840. Report of the Special Commissioner of the Revenue, Jan., 1868. Miscellaneous pamphlets, 64.

BERTRAM, JOHN, of Salem. Miscellaneous pamphlets, 45.

BOARDMAN, SAMUEL L., of Augusta, Me. Twelfth Annual Report of the Secretary of Maine Board of Agriculture, 1 vol. 8vo. Augusta, 1867. Agriculture and Industry of County of Kennebec, Maine, with Notes upon its History and Natural History, 8vo, pamph. Augusta, 1867. Legislative Documents, 13 numbers.

BOARD OF STATE CHARITIES, Secretary of. Fourth Annual Report, 1 vol. 8vo. Boston, 1868.

BOLLES, Rev. E. C., of Portland, Me. Science-Gossip for 1867, 1 vol. 8vo. London. 1867. R. B. Thomas' Almanacs, 20 numbers. Mayor's Address and Annual Reports of the several departments in Portland, 8vo, pamph. Portland, 1868. Miscellaneous pamphlets, 64.

BOWDOIN COLLEGE, Brunswick, Me. Catalogue of Officers and Students for 1867-68, 8vo, pamph. The Bugle for June and November, 1868, 8vo, pamph. Programme of the Exercises of Commencement Week, 1868.

BROOKS, HENRY M., of Salem. Sermon in North Church, Salem, Feb. 2, 1868, by Rev. E. B. Willson, 8vo, pamph. Salem, 1868. Miscellaneous pamphlets, 19.

BROOMALL, Hon. J. M., M. C. Life and Services of Gen. U. S. Grant, 8vo, pamph. Washington, 1868. Proceedings of the National Union Republican Convention, at Chicago, May 20, 21, 1868, 8vo, pamph.

BROWNE, Capt. ALBERT G., of Salem. Files of the National Era, 1848-1851, folio.

BUREAU OF REFUGEES. Fifth and Sixth Semi-Annual Reports on Schools for Freedmen, Jan. 1, July 1, 1868, 8vo, pamphlets. Washington, 1868.

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verrucæ reddish brown, the lower ones blue. Mouth, disk, and tentacles bright pink or pale flesh-color.

Ly-ce-moon Passage, near Hong Kong, China, in twenty-five fathoms, gravel, April, 1854. Dr. William Stimpson.

When contracted, so as to conceal the tentacles, this species has the form of a low, broadly truncated cone, covered with verrucæ, with an expanded base, and surmounted by another smaller cone, formed by the smoother submarginal area, with a concave summit. The specimens preserved in alcohol have contracted in various forms, but all have the tentacles fully exposed, though contracted in length to a stout conical form. One specimen retains nearly the normal form, as figured, others have the stomach so everted as to conceal the disk and even most of the column. The verrucæ of the walls are very conspicuous.

Anthopleura Duch. and Mich.

Anthopleura Duch. and Mich., Corall. des Antilles, p. 48, Pl. VII, fig. 13, 1860; (*pars*) D. and M., in Supl. Corall. des Antilles, p. 31, 1864.

Column elongated, subcylindrical. The walls with tentaculiform papillæ near the upper margin, and below with verruciform suckers arranged in vertical rows, diminishing in size and number towards the base. The papillæ and some of the upper verrucæ appear to be perforated and have the power of ejecting water when the body contracts, while the others are concave but imperforate, and serve to agglutinate fragments of shell, sand, etc. Disk narrow, tentacles rather few, long, rather stout.

The known species live buried to the tentacles in sand.

This genus is closely allied to *Aulactinia* of the Carolina coast, which has the same habit of living buried in sand, and a similar arrangement of suckers and tentacles, but in the latter the marginal appendages have a more complex character, becoming tri-lobed and crenulated, thus approaching *Oulactis* more nearly.

Duchassaing and Michelotti in their later work, have modified the characters of their genus so as to include a

species (*Cladactis? granulifera* Verrill) with verrucæ that are neither perforated nor adhesive, and another (*Bunodes pallida* V.) in which they are adhesive but not perforated. The latter appears to agree in all respects with *Bunodes*, and differs generically from *A. Krebsii* D. and M., which was the original type of the genus. As the genus is characterized in the later work it does not differ essentially from *Bunodes*.

ANTHOPLEURA STIMPSONII Verrill, sp. nov.

Base well developed, as wide as, or wider than, the column, which is elongated, cylindrical in expansion, but capable of contracting into a subglobular form. Suckers numerous, the upper ones elongated papilliform, crowded, becoming less prominent downward; those more than a quarter of an inch from the margin verruciform, with concave summits, not crowded, forming regular vertical rows, which are mostly traceable to or below the middle, when they gradually disappear; some of them, however, extend to the base, where they become distant and scarcely prominent. Tentacles nearly equal, about sixty-four in number, in three rows, which crowd upon each other. In the first are eight prominent ones, in the second twenty-four, alternating by threes with those of the first row, in the outer row thirty-two, alternating with those of the other rows. Disk not very broad. The largest specimen, partially contracted in alcohol, is about one inch in diameter and two high; tentacles nearly .5 of an inch long. When living it doubtless becomes, in expansion, several inches higher and more slender.

Color of column pale, with a sand-colored epidermis. Mouth and disk fawn-color, with two large flake-white spots indicating the antero-posterior diameter. Tentacles of a pale whitish hue, spotted on the inside with broad flake-white blotches at the outer side of the base of each tentacle of the inner row, and at the inner base of the two adjacent outer tentacles.

Hong Kong harbor, in the fourth region of the littoral zone, attached to stones far beneath the surface of the

coarse sand, but rising above it when extended, March, 1855. Dr. William Stimpson.

ANTHOPLEURA, sp.

A species resembling the preceding. Simoda, Japan. Dr. William Stimpson.

FAMILY, THALASSIANTHIDÆ.

Thalassianthidæ Verrill, these Proceedings, IV, p. 148, 1865; Trans. Conn. Acad., I, p. 461, 1869.

This family includes a great variety of forms, remarkable in having branchiform organs which arise from the disk, either within or outside of the circle of simple tentacles, intermixed with them, or even wholly taking their place. These organs may be simple or variously lobed tubercles, or they may be elongated and variously branched and subdivided, foliaceous or arborescent, and often much larger than the true tentacles.

SUBFAMILY, PHYLLACTINÆ.

Phyllactinæ Edw. and Haime, Corall., I, p. 291, 1857; Verrill, l. c., p. 462.

Actinians having both simple tentacles, and compound, arborescent or foliaceous, tentacle-like, organs on the disk, among the simple tentacles, or at the margin of the disk, and homologous with the marginal verrucæ of *Bunodes*, and other genera. These probably have the nature of branchiæ.

AMPHIACTIS Verrill, gen. nov.

Base broad. Column covered with prominent verrucæ, arranged in vertical lines. Simple tentacles in several rows submarginal, with compound and much subdivided, short, tentacle-like organs both outside and inside of them; the latter covering the disk more or less completely.

This genus differs from *Oulactis* in having complex

tentacles (branchiæ?) *within* the circle of simple tentacles in addition to those outside. *Rhodactis* has the compound tentacles between two circles of simple tentacles. *Actinotryx* has only the compound tentacles within the circle of simple ones. *Actinodactylus* has the simple and compound tentacles intermingled, and the structure of the latter is quite different. The genus, *Actinoporus* Duch. and Mich., resembles this genus somewhat, but lacks the simple tentacles, the compound ones occupying the whole surface of the disk.

This genus is, therefore, of much interest, since it completes one of the series of possible combinations of characters proper to this subfamily.

AMPHIACTIS ORIENTALIS Verrill, sp. nov.

Base broad, divided at the edge into irregular lobes. Column of firm texture, subcylindrical, covered over its whole surface with elevated, papilliform verrucæ, which are capable of contracting to low, nearly flat suckers, with concave tops. These verrucæ are most numerous and apparently more elevated on the upper parts, and are arranged in regular vertical rows, many of which can be traced to the base, the verrucæ below the middle becoming more distant and mostly contracted. The upper part of the column forms a distinct fold, denticulated or crenulated on its edge. The outer compound tentacles are numerous, short and much subdivided, the lobes being small and rounded. The simple tentacles are elongated, moderately stout, tapering, arranged in about three crowded rows, and quite numerous. The interior compound tentacles are numerous and resemble the exterior ones, but are less subdivided, those nearest the mouth being the smallest. They cover most of the disk between the mouth and the circle of simple tentacles. Mouth large, with prominent lips, having many lateral folds. The tentacles are not contracted in alcohol, but the disk is so much withdrawn that the margin of the column partially conceals them. Height of alcoholic specimen 1.25 inches; diameter of base .1 of an inch.

Color, in alcohol: lower part of column yellowish brown; upper part greenish brown; disk and tentacles dark olive-green.

Bonin Islands. Dr. William Stimpson.

The above description has been made from a specimen well preserved in alcohol. It is doubtless somewhat contracted, but retains nearly the normal form, and all the organs are well shown.

Subfamily, Discostominæ.

Discostominæ Verrill, Trans. Conn. Acad., I, p. 461, 1869 (non *Discosomæ* Duch. and Mich., Supl., p. 27, 1864).

Column apparently without verrucæ or lateral openings. Tentacles numerous, short, often verruciform or with globose ends. Disk broad, with verrucæ, papillæ, or small tentacle-like organs, arising from the same radiating chamber with the corresponding tentacle, and often scarcely differing from it in form.

This singular group is remarkable in having the tentacles but little developed in length and often confounded with verrucæ or other organs which arise between the mouth and tentacles, and are usually arranged in radiating lines. These appear to agree in everything, except position, with the verrucæ, papillæ, and similar organs that arise from the sides of the radiating chambers along the lateral surface of the body, below the tentacles, in *Bunodes*, *Anthopleura*, and many other genera.

In addition to *Discostoma*, and the other forms here described, it appears to include *Ricordea* Duch. and Mich., which becomes compound by fissiparity; *Draytonia* D. and M., with colored tubercles outside the tentacles; and, probably, *Corynactis* Allman. Other described genera may belong here, but since authors in describing these animals have not stated whether the "tentacles," scattered on the disk, arise each from a distinct chamber, like true tentacles, it is impossible to determine their true affinities with certainty. The genus, *Aureliania* Gosse, may belong here, as also *Capnea* Forbes, but

the published figures are insufficient to determine satisfactorily.

Discostoma Ehrenberg, 1834.

Discosoma Leuck. (non *Discosomus* Oken, 1816; nec *Discosoma* Perty, 1830).
Discosoma (*pars*) Edw. and Haime, Corall., I, p. 255.

Column low, smooth, smaller than the disk and base. Disk very broad, covered with numerous rounded verrucæ or tubercles, which are arranged in regular radiating lines, apparently a single series in each line, each line corresponding to the top of a single internal chamber. Tentacles not distinct from the tubercles of the disk. Type, *D. nummiforme* Leuck.

Discostoma fungiforme Verrill, sp. nov.

Plate 1, figure 7.

Base thin, broadly expanded, nearly as large as the disk. Column much narrower, low, smallest in the middle, expanding rapidly to the margin of the broad explanate disk, which has a thin, regularly scalloped and slightly undulated edge. The central region of the disk is sunken, and from the depression arises a cone, having the small sub-circular mouth at its summit. The mouth has a narrow, revolute border, which is marked by many slight sulcations. The entire disk, including the surface of the cone even to the lips, is closely covered by an immense number of small rounded tubercles, which are subequal and arranged in many narrow radiating series, between which the internal lamellæ may be seen through the disk-membrane, as narrow, dark, radiating lines. The tubercles are mostly closely crowded in a single row in each series, but in some cases are so crowded as to form two alternating rows. Breadth of disk, in alcohol, .8 of an inch; height .3 of an inch.

The above description has been prepared from specimens preserved in alcohol. The disk and tentacles do not appear capable of contracting. Young specimens,

.25 of an inch across the disk, are relatively higher, but the disk considerably exceeds the column. The tubercles are much fewer and relatively larger and plainly arranged in single radiating series.

The figure, though drawn from life, represents the base as altogether too narrow and the tubercles not sufficiently numerous.

Color variable, usually purple, often light green.

Port Lloyd, Bonin Islands, attached to branches of *Madrepora*, in one fathom. Dr. Wm. Stimpson.

This species resembles *Ricordea florida* D. and M., but the latter becomes compound, having several mouths when adult.

HOMACTIS Verrill, gen. nov.

Column low, cylindrical, with a distinct fold near the margin, substance firm, surface smoothish. Disk not much wider than the column, concave, the whole surface, except a narrow region about the mouth, covered with small, rounded, perforated tubercles, arranged in wide radiating series, in which they are crowded in several transverse rows. Tentacles marginal, in life longer, with imperforate tips; in alcohol scarcely different from the tubercles in appearance. Mouth large.

HOMACTIS RUPICOLA Verrill, sp. nov.

In alcohol the base is equal in width to the column, which is low, cylindrical, with many strongly marked transverse folds due to contraction, which are crossed by fine longitudinal wrinkles. Just below the tentacles is a well marked fold; substance firm. Disk broad, but scarcely exceeding the column, deeply concave, covered by about fifty broad, radiating groups of very small and numerous, rounded, perforated tubercles, which are closely crowded and form four or five irregular transverse rows in each radiating band. These radiating groups correspond with the internal chambers, and the principal ones extend from near the mouth to the circumference. Between these are smaller ones, some of which extend half

way to the centre and others much less. The marginal tentacles can scarcely be distinguished from the other tubercles in the alcoholic specimen, but in life are "longer, flattened, with broad, white, imperforate tips." Mouth large, with thickened lips, which have many small folds, with two rounded tubercles at one angle. Height, in alcohol, .5 of an inch; diameter .1 of an inch.

Sides of column, in life, greenish gray, streaked with pinkish brown towards the base. Disk greenish gray, with the margin of the mouth white. Marginal tentacles with white tips.

Hong Kong, attached in crevices of the rocks in the fourth region of the littoral zone, March, 1855. Dr. Wm. Stimpson.

Stephanactis Verrill, gen. nov.

Column subcylindrical, somewhat elongated, not verrucose, substance firm and dense. Disk exceeding the column, covered with regular radiating lines of short, unequal tubercles. The outer tubercles or tentacles are largest and divided into several (three to five) short rounded lobes; those next within are two or three lobed; the innermost are simple, rounded or papilliform verrucæ. The disk and tentacle-like organs do not appear to be capable of contraction, being fully expanded in alcohol.

This genus resembles in general appearance *Actinoporus* Duch. and Mich., but does not have the tentacular organs subdivided as in that genus, nor the walls perforated by vertical rows of pores (suckers?). The tentacle-like tubercles resemble, in form and arrangement, those of *Aureliania* Gosse, but are more numerous, and the latter is said to be highly contractile in all parts, and appears to differ in other characters from the present form. It may, however, eventually prove to be the same genus.

Stephanactis Indica Verrill, sp. nov.

In alcohol the base is narrower than column, the latter is largest in the middle, decreasing towards the summit,

longer than broad; its texture firm and dense, its surface longitudinally sulcate, with rather wide ridges, which are crossed by deep transverse wrinkles due to contraction, the surface closely lined by fine vertical wrinkles. Edge of disk exceeding the column and a little revolute, the upper surface covered by about forty radiating rows of short unequal tubercles, five or six in each row, the rows being alternately wider and narrower, the wider ones projecting beyond the outer edge more than the narrower ones, and terminating in a three-lobed or tridentate tubercle, the middle lobe being longest; upon the inner side of this are two small rounded median tubercles, followed by a deeply bilobed tubercle, which is succeeded by three or more, simple, verruciform tubercles, extending to near the mouth. The narrower rays terminate outwardly in a shorter and much smaller tubercle, with a pointed central lobe, the two lateral ones being scarcely developed; on the inside of this are two small, median, rounded tubercles, often slightly bilobed, followed by a more elevated bilobed tubercle, which is succeeded by three or more small, usually simple, rounded tubercles. Mouth in the alcoholic specimen much protruded and everted. Height of the preserved specimen .6 of an inch; diameter of column .4 of an inch.

Selio Island, Gaspar Straits, February, 1854. L. M. Squires.

Corynactis Allman, 1836.

Corynactis (*pars*) and *Melactis* Edw. and Haime, Coralliaires, I, pages 258 and 260, 1857.

Column smooth, versatile in form. Disk much expanded, convex or concave, with the mouth depressed or elevated on a cone, according to the state of contraction. Tentacles more or less scattered on the disk, the outer ones largest, with a pedicel and an enlarged or globose tip. Whether more than one of these organs arise from the same chamber, I am, at present, unable to determine, but this seems probable from the figures.

The following species, and also *C. viridis* of Europe,

protrudes and retracts the mouth at will, therefore the genus, *Melactis* E. and H., which was based on the prominent mouth of *C. vas* and *C. globulosa*, as figured by Quoy and Gaimard, must be dropped, unless sustained by other characters at present unknown.

CORYNACTIS ANNULATA Verrill.

Melactis annulata Verrill, these Proceedings, Vol. V, p. 50, Pl. 1, figs. 8, 8a, 1866.

Base expanded, entire or lobed. Column smooth, at times short cylindrical, in full expansion usually smallest in the middle, gradually enlarging both to the base and summit. Disk in full expansion wider than the column, sometimes convex, at other times concave. Mouth small, rounded, either depressed or raised on a prominent cone, the lips with many radiating folds. Tentacles occupying the outer half of the disk, the inner ones short, tuberculiform, scattered, the outer ones much larger, somewhat elongated, the pedicel nearly as thick as the slightly enlarged, rounded end. Height, in expansion, .4 of an inch; diameter of disk .32 of an inch. Color of column light rose, with a narrow ring of bright vermilion just below the tentacles, at the margin. Mouth, disk, and tentacles nearly white, tinged with rose.

False Bay, Cape of Good Hope, abundant on stones and shells on rocky bottoms, in fifteen to twenty-five fathoms, October, 1853. Dr. Wm. Stimpson.

ADDITIONS AND CORRECTIONS.

SINCE printing the earlier parts of this Synopsis several changes in the genera have become necessary, while some additional specimens have been found, belonging to the collection, which were previously overlooked. In order to illustrate more fully the coral faunæ of some of the localities visited, I have also added a few species not collected by the Expedition, which are new or little known. These are all in the Museum of Yale College.

ALCYONARIA.

GORGONIDÆ.

LITIGOGIA CUSPIDATA Verrill, Trans. Conn. Acad., I, p. 403, = *Leptogorgia cuspidata* V. (Vol. IV. p. 186).

GORGONIA ALBICANS Kölliker. — The peculiar specimen mentioned under *Lophogorgia palma* E. and H. (p. 187) proves to belong to this species.

PLEXAURIDÆ.

EUPLEXAURA Verrill, gen. nov.

The species referred doubtfully to *Plexaura friabilis* Lamx., has spicula that differ widely from those of *Plexaura*, and although they approach those of *Plexaurella* more nearly, they differ so much as to render it impossible to refer the species to that genus without modifying its character considerably. Therefore I propose to consider it the type of a new genus.

In external characters it resembles *Plexaurella*, with rather large, open cells. The spicula are mostly short, stout, blunt, warty spindles, of rather small size, with a

few small, simple double-spindles, and rarely, small, irregular crosses.

Plexaura differs in having long, acute spindles, some of which are usually very large, mingled with others that are much smaller, and small warty clubs. *Plexaurella* has mostly rather small, warty double-spindles, mingled with numerous warty crosses of similar size, with central naked bands.

EUPLEXAURA CAPENSIS Verrill, sp. nov.

Plexaura friabilis Verrill, Vol. IV, p. 186; (*pars*) Lamouroux?

This is not the *P. friabilis* of Edw. and Haime, Duch. and Michelotti, Kölliker, and other modern writers, and may not have been known to Lamouroux. It is probable, however, that he confounded more than one species under that name, and his East Indian specimens may be this species. As the name is generally given to a West Indian *Plexaura*, it seems best to give a new one to this.

Spicula small, mostly short, oval or oblong, and crowdedly covered with large, very rough warts, which are mostly dilated and echinulate at the summits. Others are similar, but shorter, and approach the form of warty heads. Others approach the form of short, thick double-spindles, with two wreaths of large rough warts near the middle, and a terminal cluster of smaller ones at each end. Occasionally there are compound cross-spicula, about as broad as long, the ends thickly covered with large, very rough warts, and rather obtuse or truncated.

The stout spicula measure .204 millimetres by .108 millimetres; .180 by .108; .180 by .096; .180 by .084; .168 by .096; .156 by .096; .144 by .108; .144 by .096. The stout double-spindles .156 by .108; .144 by .072; .132 by .096 .120 by .072. The crosses .120 by .120; .144 by .108. Heads .144 by .108.

PRIMNOIDÆ.

The recent discovery of several genera intermediate between *Muricea* and *Primnoa* (*Echinogorgia*, *Paramuricea*, *Acis*, *Thesea*, etc.) renders it necessary to unite the

two groups in one family. The *Plexauridæ* would then include only *Plexaura*, *Eunicea*, *Plexaurella*, and allied forms.

MURICEA FLEXUOSA Verrill, Amer. Jour. Science, Vol. 45, p. 412, May, 1868, = *Lissogorgia flexuosa* V. (Vol. IV, p. 187).

The genus, *Lissogorgia* V., based upon the *Gorgonia cancellata* Dana, seems unnecessary, since the typical species proves to belong to *Paramuricea* Kölliker, a genus established at nearly the same time and based upon more important characters. *Villogorgia* and *Blepharogorgia* (*pars*) Duch. and Mich. appear to be other synonyms, but the typical species of the latter may, perhaps, form a distinct genus. (See American Jour. Science, Vol. 45, p. 413 and Vol. 46, p. 143.)

In this Family the forms and structure of the spicula appear to be the safest guides to the true affinities of the species. In the recent very valuable and important work* of Dr. Albert Kölliker, the spicula of most of the genera are beautifully illustrated.

ASTROGORGIA Verrill.

American Journal of Science, Vol. XLV, May, 1868, p. 414.

Cœnenchyma and surface of verrucæ granulous and composed of rather small spindles, closely united together, with some irregular, small, rough double-heads and clubs. Verrucæ prominent, eight-rayed in contraction, the spicula being arranged in eight groups. Tentacles often not wholly retracted, their bases strengthened by eight groups of conspicuous, fusiform spicula, similar to those of the cœnenchyma, arranged in V-shaped lines. When the tentacles are nearly withdrawn the basal spicula form a stellate figure at the mouth of the cell.

ASTROGORGIA SINENSIS Verrill, op. cit., p. 412, = *Muricea Sinensis* V. (Vol. IV, p. 187, *Plate 5, figure 5, 5a.*)

The verrucæ in this species form broad, low, rounded cones, or are nearly hemispherical. The spicula in the

* Icones Histiologicæ, zweite Abtheilung, Leipzig, 1865.

bases of the tentacles are red and conspicuous, like those of the cœnenchyma. Spicula mostly light red with some grayish yellow. Longer spindles long, often bent, gradually tapering to the ends, which are slender and acute, covered over the whole length, with rough truncated projections, which are largest in the middle and diminish to each end. Shorter spindles considerably stouter, with more crowded projections, often with one end obtuse and the other acute, smaller spindles slender, rather acute, with unequal scattered warts. Irregular spicula frequently composed of a slender axis, naked in the middle, with an irregular group of four or five large, rough, somewhat subdivided warts at each end; others have similar warts scattered over the whole length; others have large rough warts at one end, which gradually diminish towards the other end, where they are quite small, thus producing a somewhat club-shaped form. A few very small, simple, cross-shaped spicula occur.

The longer spindles measure .420 millimetres by .090. millimetres; .372 by .084; .360 by .096; .348 by .084; .324 by .096; .300 by .072. The stouter ones .288 by .084; .288 by .072; .264 by .084. The smaller ones .228 by .084; .216 by .042; .180 by .060; .180 by .048. Irregular ones .144 by .072; .108 by .060; .108 by .048; .096 by .060.

ANTHOGORGIA Verrill, op. cit., p. 412.

Verrucæ prominent, tubular, the summit eight-rayed in contraction, formed by a thin integument, in the surface of which, large, long, mostly bent spindles are imbedded at various angles, and so interlaced as to form a sort of network of spicula, with depressions between. Cœnenchyma thin, granulous, filled with large, warty spicula, similar to those of the verrucæ, but usually shorter and stouter.

ANTHOGORGIA DIVARICATA Verrill, op. cit., p. 412, = *Muricea? divaricata* V. (Vol. IV, p. 188, *Plate 5, fig. 6, 6a.*)

The enlarged figure of the verrucæ (Plate 5, fig. 6a) does not represent the spicula properly. They should be

much more numerous, covering the whole surface, and interlaced at all angles, leaving small, often nearly square depressions between. Spicula white, mostly long, rather slender, often curved spindles. The longer ones taper gradually towards the ends, which are not very acute; they are covered on all sides with closely crowded, rather regular, conical warts. Some of the smaller spindles have the warts less crowded and more regular. The stouter spindles are frequently somewhat oblong in outline, being of nearly uniform size to near the ends, where they taper abruptly; their warts are larger, rough, often lobed, unequal, and closely crowded. Besides these there are many short, thick, irregular spicula, covered with very unequal, rough, irregular warts.

The longer spindles measure .552 millimetres by .108; .516 by .084; .504 by .072; .492 by .096; .480 by .096; .480 by .084. The stouter spindles .540 by .120; .456 by .144; .420 by .096; .432 by .120; .324 by .072. The irregular spicula .252 by .108; .204 by .120.

Echinomuricea Verrill.

American Journal of Science, Vol. 47, p. 285, March, 1869.

This genus has been established for the following remarkable species, which appears to be sufficiently distinct from *Acanthogorgia* and *Paramuricea*, to both of which it is allied. It is peculiar in having the verrucæ surrounded at base by numerous very long, stout, thorny and branched, spine-like spicula, which are crowded and somewhat imbricated, not placed in whorls.

Echinomuricea coccinea Verrill, l. c., p. 285, = *Acanthogorgia coccinea* V. (Vol. IV, p. 188, Pl. 6, fig. 7, 7a).

Isidæ.

Parisis laxa Verrill, Vol. IV, p. 190.

This species occurs, also, as I am informed by Dr. Lutken, in Formosa Channel.

MOPSELLA JAPONICA Verrill, Vol. IV, p. 190.

Specimens of this species, from Hakodadi and Bay of Yeddo, recently received from Mr. W. H. Dall, differ somewhat from the type.

They are more densely branched, the branches less divergent and often coalescent, leaving large irregular openings. The branches and branchlets are also stouter, crooked, obtuse at the ends. Verrucæ mostly crowded on the edges of the branches, often entirely covering the smaller branchlets but generally scattered or wanting on the sides of the larger branches. They are relatively larger, rather prominent, round, with depressed and concave summits, showing in the centre a cluster of convergent, bright yellow polyp-spicula. Cœnenchyma finely but roughly granulous with small rough spicula.

One specimen is bright lemon-yellow, the others deep red.

One specimen is 2.25 inches high and 2.75 broad; another is 3 inches high and 1.5 broad. Diameter of larger branches at internodes .10 to .12 of an inch; of branchlets .06 to .08; length of terminal branchlets rarely more than .30; distance between branches usually .25 to .35; diameter of verrucæ .04 to .05.

ALCYONIDÆ.

ALCYONIUM? Verrill, Vol. IV, p. 191, = *Lobularia Verrillii* Gray; Annals and Mag. Nat. Hist., Series 4, Vol. 3, p. 121, Feb., 1869.

This species is, as yet, known only from a small and imperfect specimen. Not having had an opportunity to examine its spicula, I am unable to refer it to its proper genus. It cannot belong to *Lobularia* as defined by Dr. Gray. Sea of Ochotsk.

NEPHTHYIDÆ.

EUNEPHTHYA Verrill.

American Journal of Science, Vol. 47, p. 284, March, 1869.

This genus, established for the following species and *E. glomerata* from Greenland, is peculiar in having the

verrucæ prominent and covered with rough, thorny, club-shaped or branched spicula, with the ends projecting from the surface.

Nephthya has the verrucæ covered with long, regular, or curved, warty spindles, appressed to the surface.

EUNEPHTHYA THYRSOIDES Verrill, l. c., p. 284, = *Nephthya thyrsoidea* V. (Vol. IV, p. 192, Pl. 6, figs. 8, 8a, 8b).

Spicula mostly long, thorny, club-shaped, .600 of a millimetre to 1.00 long, by .100 to .200 thick; and stouter very thorny clubs, .300 to .500 long, by .125 to .250 broad; and rough, sharp, three-pronged spicula, .275 to .325 long, by .150 to .250 broad. The thorny ends of these spicula project from the surface of the verrucæ, especially towards their summits, giving it a very rough appearance.

Dr. Gray, in the work cited above, erroneously places this species as a synonym of *Verrilliana thyrsoides* Gray (*Ammothea thyrsoides* Ehr.), from which it differs widely.

SPONGODES CAPITATA Verrill (Vol. IV, p. 193), = *Spoggodes capitata* Gray, op. cit., p. 128.

SPONGODES GRACILIS Verrill (l. c.), = *Spoggodia gracilis* Gray, op. cit., p. 128.

The genus *Spoggodia* Gray (non Dana), has been separated from the typical species, owing to the more scattered arrangement of the polyps, "prominent from the sides or forming the tips of the branchlets." These characters seem to me insufficient for the establishment of a genus. Moreover *S. gigantea* V. (Vol. IV, p. 192) combines the characters of the two groups, having both single polyps scattered on the sides of the branchlets and others clustered at the ends and surrounded by large, spine-like spicula.

According to the generally accepted rules of orthog-

raphy, the name of this genus should be *Spongodes* (or *Spongodia*) not *Spoggodes*, or *Spoggodia*.*

CORNULARIDÆ.

TELESTO RAMICULOSA Verrill (Vol. IV, p. 194), = *Telesco ramulosa* Gray, op, cit., p. 22.

TELESTO? NODOSA Verrill (l. c.), = *Telescella nodosa* Gray, op. cit., p. 22.

Dr. Gray has proposed for this doubtful species the subgenus, *Telescella*, based on its peculiar mode of branching. This appears quite unnecessary, especially until the species is better known.

A microscopic examination of one of the original specimens recently received from the Museum of Comparative Zoölogy shows that, in all probability, it does not belong to the Alcyonaria, since there are no spicula whatever. When treated with caustic potash the tubes are seen to consist of an amorphous membranous basis, with various foreign substances—minute grains of sand, Foraminiferæ, Diatoms, etc.,—imbedded in it, the annulations of the tubes being thicker ridges of the amorphous material, which is insoluble, or nearly so, in caustic potash. In some parts there are minute, nearly spherical, nucleated cells, either scattered, or closely grouped in a single layer.

The condition of the specimens does not admit a reliable determination of their nature. They may be tubes of some annelid, or small crustacean, since many genera of Amphipods, like *Cerapus*, make similar tubes.

There appears to be no sufficient reason for Dr. Gray's change in the spelling of this generic name.

* See Section 14 of the Rules of Zoölogical nomenclature adopted by the British Association, 1865; also reprinted in the American Journal of Science, July, 1869.

MADREPORARIA.

MADREPORIDÆ.

MADREPORA MICROPHTHALMA Verrill, sp. nov.

Corallum numerously divided, somewhat arborescent, the branches subpinnate, spreading mostly in one plane, proliferous towards the ends, covered with small, unequal, tubular corallites, which have very small, circular, regularly stellate cells, surrounded by thickened borders.

The main trunk gives off branches subpinnately on two sides, which diverge rapidly and are usually less than a quarter of an inch apart. A few smaller branches also rise from the front and back sides of the trunk and main branches, which do not conform to the common plane of the other branches; the secondary branches and branchlets arise somewhat irregularly from the larger branches, varying from .12 to an inch or more apart below, but becoming crowded and strongly divergent near the ends. The branches and branchlets taper rapidly to the tips, which are subacute and terminated by a small, slightly prolonged terminal corallite, of quite porous but firm texture, rounded at tip and perforated by a very small cell, which is regularly stellate with six primary septa that meet at the centre and other rudimentary septa of the second cycle between them. Lateral corallites very unequal in size and elevation, diverging at an angle of about 45°, tubular, somewhat tapering, truncated a little obliquely at summit and rounded, the border of the cell considerably thickened, especially on the outside, the texture firm but very porous and spongiform, the surface evenly echinulate, not costate. The cells are very small, regularly stellate, with six, well-developed, equal septa, which nearly meet at the centre. Cœnenchyma firm, finely echinulate.

Height 4.25 inches; breadth 6; diameter of larger branches .45; of terminal branchlets .25 to .30; length of the latter .50 to .75; length of terminal corallites .10; diameter .08 to .10; diameter of cell .02; length of lateral corallites .02 to .15, the average about .10; diame-

ter .02 to .07, average about .06; diameter of largest cells about .015.

Loo Choo Islands. Rev. S. W. Williams.

This species is allied to *M. formosa* Dana; *M. brachiata* Dana; *M. laxa* Lam.; and *M. gracilis* Edw. and Haime, but differs from all in having much smaller cells, as well as in its mode of branching. The first has longer, more slender and acute, and scarcely proliferous branches, with much longer and more slender corallites, which are more nearly equal and not crowded nor thickened, with much larger cells. The surface is more porous and more coarsely granulous. *M. brachiata* has much stouter and less subdivided branches, with much longer corallites, which are crowded, less unequal, and obliquely truncated at summit, with oval and large cells. *M. laxa* differs in its mode of branching and larger verrucæ and cells. *M. gracilis* has nariform corallites.

M. arbuscula resembles it somewhat in mode of branching, but has stouter branches and much larger cells and corallites, and its surface is coarsely porous and scabrous, costate on the corallites.

MONTIPORA EXESA Verrill, sp. nov.

Montipora foliosa? (Vol. V, p. 25), *non* Edw. and Haime.

Since describing this coral I have been able to examine a large and fine specimen of *M. foliosa* and must regard it as a distinct, though allied, species.

This resembles it in the character of the lower surface, and probably, also, in its mode of growth, but differs in having on the upper side much coaser, thicker, and round-topped papillæ, most of which are united more or less into groups, crests, and long ridges, which are united by thin cross ridges, so as to form very unequal and irregular deep pits over the whole surface, which give it a rough, eroded and excavated appearance. The cells are inconspicuous, very small (scarcely .02 inch), and situated at the bottom of the pits and often among isolated papillæ. They have six larger septa alternating with six very rudimentary ones. The external surface is very

porous and spongy, not papillose, and covered with more distinct and larger cells (about .03 inch), which are surrounded by a thickened, roughly spinulose and porous border, somewhat elevated above the general surface. They are numerous but irregularly scattered, and have twelve distinct septa, six of which are larger.

Gaspar Straits.

MONTIPORA FOLIOSA Edw. and Haime.

Madrepora foliosa Pallas, 1766 (*non* Ellis and Solander, 1786, *nec* Esper, Tab. LVIII B, fig. 1, 2, 1797).

Porites rosacea Lamarck, 1816 (*non* Lamouroux, Plate 52).

Montipora foliosa Edw. and Haime, Corall., Vol. 3, p. 212 (*non Porites foliosa* Ehr., *nec Manopora foliosa* Dana).

A specimen of this species, in the Museum of Yale College, consists of a large cluster of very broad, thin, convolute, unequal fronds, which are arranged somewhat like the petals of a half-blown rose, but are somewhat irregular in form and position. There are three fronds between the centre and the outside on nearly all parts. The spaces between the fronds at the summit, vary from 2 to 3.5 inches. Some of the fronds are 20 inches broad, and over 12 wide. The entire height of the coral is 14 inches; diameter 18. The fronds are thin throughout, scarcely exceeding .25 of an inch in any part, and usually about .12 at one or two inches from the margin, which is much thinner and translucent. Texture very porous, rather fragile. On the outside the surface for an inch or more from the margin is nearly destitute of cells and not papillose, but crossed by irregular and very unequal, distant, vertical ridges. Below this the cells gradually become more numerous and crowded, and the surface more uneven. The cells are between .02 and .03 of an inch in diameter, slightly elevated, and surrounded by small, rounded, rough papillæ, and with similar minute papillæ between. Septa small, six distinct. On the inner surface the cells are of about the same size, but are surrounded by much higher, very slender, rough papillæ, while similar but shorter papillæ are thickly crowded over the whole surface between the cells. Towards the

margin the papillæ form longitudinal rows, or narrow crests. Septa twelve; six larger, alternating with very small ones.

(?) Ceylon. Rev. G. A. Apthorp.

This fine species has been so often confounded with several others that are similar in form or mode of growth, that it seems useful to add the above particulars from a specimen that appears to agree with the typical form described by Pallas, and also by Edwards and Haime. The *Montipora grandifolia* of Dana, of which the original specimen is before me, is very closely allied to this and may be only a variety of it. The character of the upper surface is identical in nearly all respects, but the lower surface has more numerous cells, which extend to the margin, or nearly so, and are somewhat more prominent and a little larger, with the septa more developed, the primary ones a little thickened, alternating with six narrower secondaries. The texture appears firmer and the surface less rough and scarcely papillose, even around the cells.

The species described as *Porities foliosa* by Ehrenberg, and afterwards adopted by Dana, appears from the description to be quite distinct.

MONTIPORA LICHENOIDES, Verrill, sp. nov.

Corallum encrusting below, explanate above, rising into irregular, thin, more or less contorted, plicate or crispate fronds. Near the margin the fronds are about .05 of an inch thick, the exterior for about an inch from the margin is covered with irregular vertical ridges or plications, with small scattered papilliform processes, which become more numerous and larger below, where they frequently unite into larger compound papillæ, between which are smaller rounded ones thickly scattered over the surface. The cells are very small, about .01 of an inch, and are irregularly scattered among the smaller papillæ, on the bases of the larger ones, or elevated among the summits of the compound ones; towards the margin they are remotely scattered over the surface and wholly immersed. Septa

twelve, six well developed and a little thickened, alternating with six very narrow ones. The upper surface of the frond is covered, on the lower part, with very unequal, densely crowded, slender, round-topped papillæ, which are mostly united in irregular clusters; towards the upper part of the fronds the papillæ stand in vertical rows or clusters, which near the margin unite and form thin, elevated costæ or crests, the edges of which are divided more or less into thin and compressed, or round and slender papillæ, which have rounded summits, sulcated sides, and a minutely roughened surface. The cells of the upper side are not numerous, distantly scattered among the papillæ and between the crests, quite small and inconspicuous, but larger than those of the lower surface; diameter about .02 of an inch. Their septa are well developed, as in those of the lower side.

The only specimen seen is about four inches in breadth and the same in height, the free portions of the frond rising about two inches. It encrusts the branches of a dead *Madrepora*.

Loo Choo Islands. Rev. S. W. Williams. Museum of Yale College.

This species is allied to *M. foliosa*, *M. exesa*, *M. grandifolia*. The cells are, however, much smaller than in either of those species, especially upon the lower side, and its texture is more firm and solid, while its lower surface is more papillose. Its upper surface is quite unlike any except *M. exesa*, but even that species has the papillæ more regular and the surface more distinctly divided into areolations by the elevations, while the papillæ themselves are much shorter, thicker, more obtuse, and more completely united.

MONTIPORA PATULA Verrill, sp. nov.

Corallum thin, partially explanate, attached and encrusting at the centre, the edges free and nearly horizontal for a width of four inches or more. The corallum at half an inch from the edge is .15 of an inch thick; at 3 inches, .30; texture very porous but tolerably firm.

The lower surface is destitute of papilliform processes, and nearly even, composed of a very porous spongiform tissue, roughened with minute sharp points. The cells are very small (.01 inch), regular, wholly immersed, surrounded by a circle of small spinules, thickly scattered over the surface, except towards the edge where they are generally more distant and often larger, usually with twelve very small, rudimentary septa. Upper surface very porous, somewhat undulated, a little uneven, thickly covered with small, unequal, prominent, round-topped papillæ, which have a very open spongiform texture, their surface covered with rough projections. Sometimes these papillæ are less developed and appear like small rounded clusters of spongy trabiculæ, which project all over the surface and are lacerately divided. Cells thickly scattered over the surface, each usually surrounded by a cluster of four or five of the larger papillæ, considerably larger than those of the lower side (about .03 of an inch), with six quite distinct septa, which extend about one-fourth across the cells. Towards the central parts of the coral the cells are generally somewhat larger and have twelve septa, six very narrow ones of the second cycle alternating with the six larger primary ones.

Close to the edge the papillæ sometimes form radiating rows, or unite into short, thin ridges. The largest papillæ are scarcely .02 of an inch in diameter, and about .04 in height.

Hawaiian Islands. Museum of Yale College. Numerous specimens are also in the Museum of Comparative Zoölogy, which were collected by Mr. A. Garret.

This species appears to grow in broad horizontal fronds, having an undulated surface, and attached or encrusting in the central parts, the edges becoming free. In the character of the upper surface it resembles somewhat *M. grandifolia* Dana, and *M. expansa* Dana, but has a much more porous texture and thicker and rounder papillæ, but both the latter species have a very different lower surface, with prominent cells, which are three or four times broader, and their fronds are thinner and firmer. The even, nearly smooth lower surface, with minute punc-

tiform cells, is quite unlike that of most other known species.

TURBINARIA DICHOTOMA Verrill, sp. nov.

Corallum large, dichotomously branched. Branches stout, subcylindrical, often flattened at the end, covered with large, somewhat prominent corallites, which open upward and are uniformly scattered on all sides of the branches, but become crowded and unequal at the ends, where many small corallites are seen among the larger ones, from which they appear to rise by interstitial or extramarginal budding. The lateral cells are about a quarter of an inch broad, shallow, nearly circular, and arranged in five or six, irregular, vertical or somewhat spiral rows, those in the same row mostly from .3 to .4 of an inch apart, while those of adjacent rows are often less than their own diameter apart. The cells are elevated on low, broad eminences, which spread at their bases and are so closely appressed to the sides of the branches that the cells open obliquely upwards. Cœnenchyma roughened with papilliform and small spinous processes, intermingled with others which are of various irregular forms, often crest-like, or variously convoluted, narrow ridges. Among the interstices of these are numerous irregular pores, which are larger than in most other species. Septa in four cycles, usually, in the larger cells, with some rudiments of the fifth cycle, the number varying from fifty to sixty; those of the first two cycles nearly equal, about one fourth as wide as the cell, the inner border perpendicular or a little concave, the summit obliquely truncated, not exsert, the upper end joining the margin and becoming confused with the irregular, spinose processes of the cœnenchyma, which cover the exterior of the corallites and form the border of the cells. Septa of the third cycle about one quarter narrower; those of the fourth and fifth cycles very narrow and often rudimentary, alternating with the wide ones of the preceding cycles. Columella broad, occupying about half the breadth of the cells, its surface convex, formed by

numerous small, rough, convoluted, and intricately united trabiculæ, with small, irregular openings among them, the free ends of rough papilliform processes forming the surface. Color of the unbleached coral dark brownish black. Diameter of the terminal branches 1 to 1.25 inches; diameter of lateral cells .20 to .25; depth .08 to .10. The terminal cells are mostly smaller and relatively much deeper.

Locality unknown, most probably Bonin or Loo Choo Islands. Dr. Wm. Stimpson.

Pocilliporidæ.

Observations upon the polyps have shown that this family has the structure of the *Madreporaria*, and no affinity with *Milleporidæ* and similar Hydroid corals.* The twelve well-developed and regular septa, seen in such species as *P. elongata*, *P. stellata*, *P. plicata*, etc., also give ample evidence of their intimate relations to the true Polyps, and are inconsistent with Hydroid structure. Occasionally a cell divides by fissiparity, and in that case has twenty-four septa just before division. The transverse plates have a concentric structure and are often seen incomplete, with a round or oval opening through the centre. It appears worthy of separation from *Favositidæ* on account of the imperforate walls, abundant cœnenchyma and other characters.

Pocillipora gracilis Verrill, sp. nov.

Corallum cæspitose, low, and densely branched, the branches slender round, rarely with intervals of a quarter of an inch between the branchlets. The branches and branchlets are dichotomous and diverge at acute angles. The terminal branchlets are rarely a quarter of an inch long, about .08 of an inch in diameter, with obtuse or rounded tips. Cells shallow, .03 of an inch in diameter, or a little less, with a small, prominent columella, and

* On the Affinities of the Tabulate Corals, by A. E. Verrill, Proc. of the American Association for Advancement of Science, 1867, p. 148.

twelve very narrow, rudimentary septa, six of which can usually be traced across the bottom of the cell to the columella. Spaces between the cells usually less than their diameter. Surface of the cœnenchyma covered with very small, scattered, rough points. Color of unbleached coral light brownish yellow. Height 2.5 inches; breadth about the same; diameter of the main branches .25 of an inch.

Loo Choo Islands. Dr. Wm. Stimpson.

This species is allied to *P. cæspitosa* Dana, from the Sandwich Islands, but the latter has larger cells, which are much more closely crowded near the ends of the branchlets, leaving only a thin wall between, therefore becoming polygonal, and the columella is not distinct. The terminal branchlets are also more angular and pointed, more irregular, and have the cells opening obliquely upward. *P. bulbosa* Lam. has much longer and stouter branches, which are less subdivided and more angular at the ends. Its cells are still larger and towards the ends of the branches they are oblong-polygonal, with only thin walls between them, and open obliquely upward.

Pocillipora cæspitosa Dana.

Pocillopora brevicornis (*pars*) Dana; Edw. and Haime (*non* Lamarck).

The Museum of Yale College possesses a large and fine series of this species from the Hawaiian Islands, collected by Mr. Horace Mann, and also several of the original specimens described by Prof. Dana. One specimen from the U. S. Exploring Expedition, labelled *P. brevicornis* by Dana, differs from the ordinary form in having the branches shorter and thicker, with the branchlets shorter and more crowded upon their enlarged ends, thus producing a thicker and lower clump than usual. But in the series there are various intermediate forms between this and those with long branches and slender spreading branchlets. Like most specimens of this species from the Hawaiian Islands, it has the large, flat, open bulbs made among its branches by *Harpalocarcinus marsupialis* Stimp-

son,* which renders it probable that this specimen was from that locality. I am not aware that *P. brevicornis* has been attributed to those Islands by any other author, and hence infer that the species does not really occur there, since it was not in the extensive series of Pocilliporæ collected by Messrs. H. Mann and W. T. Brigham, nor the large collection made by Mr. A. Garret at the same place for the Museum of Comparative Zoölogy.

Pocillipora brevicornis Lamarck.

Pocillopora brevicornis (*pars*) Dana, Zoöph., p. 526, Pl. 49, fig. 8; Edw. and Haime, Vol. 3, p. 304.

Two specimens from Ceylon, collected by Rev. G. A. Apthorp, are in the Museum of Yale College. These are the original Ceylon specimens described by Dana. They agree well with the later description by Edwards and Haime, and appear, therefore, to represent the typical form of this species. They are also quite distinct from the specimen referred to the last species, with which they were probably not directly compared by Prof. Dana, since that specimen was not sent here until long after his work was published.

This species differs from *P. cæspitosa* in its branches, which are much more equal and regular in length and size, and rise more nearly parallel, leaving more uniform spaces between, and are also longer and less subdivided, the branchlets taking the form of ascending, elongated, sometimes proliferous verrucæ, which are often appressed on the sides, but are shorter and crowded on the summits of the branches. The cells are larger and much more crowded on the sides of the branches, seldom becoming circular. The septa are rudimentary, and the columella usually wanting, the cells on the sides of the branches being usually shallow, with a nearly flat bottom.

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*For an account of this singular parasite, see the American Journal of Science, Vol. 44, p. 126, 1867. I have noticed a similar parasite on *P. elongata* Dana, from Ceylon, near the top of one of its very thick branches, but never among the thick-branched *Pocillipores* of the Hawaiian Islands.

The texture is less firm, and the coral is more cellular and lighter than in *P. cæspitosa*.

One specimen has a bulb similar to those made by *Harpalocarcinus marsupialis*, but belonging, probably, to another species of the same genus, since it differs considerably in form. The aperture is closed, except a few small openings above. A similar bulb occurs on *P. elongata* Dana, from Ceylon.

Pocillipora Danæ Verrill.

Pocillopora favosa (*pars*) Dana, Zoöph., p. 528, Plate 50, fig. 1 (*non* Ehr.; Edw, and Haime).
Pocillopora Danæ Verrill, Bulletin Mus. Comp. Zoölogy, p. 59, 1864.

Under the name of *P. favosa*, Prof. Dana included specimens both from the Feejees and Hawaiian Islands. A careful examination of his original specimens, and comparisons with large series more recently collected, have convinced me that the specimens from these two localities really belong to distinct species, both of which appear to differ from the typical specimens described by Ehrenberg from the Red Sea. The Feejee species may be distinguished by the following characters.

Branches moderately stout, variable both in size and length, quite irregular, the ends usually enlarged, often compressed and lobed, the summits very cellular, usually with subobsolete verrucæ, but the younger branches often terminated by prominent ones. Sides of the branches with rather large, prominent, obtuse, irregularly scattered verrucæ, which rise obliquely and are scarcely appressed. Cœnenchyma compact, with very fine spinlule-like grains evenly scattered over the surface. Lateral cells between the verrucæ rather small, circular, with the septa and columella scarcely distinct, though in some cells near the base twelve very narrow septa are visible. Texture rather firm.

Feejee Islands. J. D. Dana. U. S. Expl. Expedition.

Pocillipora aspera Verrill, sp. nov.

Pocillopora favosa (*pars*) Dana, loc. cit. (*non* Ehrenherg).
Pocillopora plicata (*pars*) Dana, op. cit., p. 534.

Corallum branching much as in the preceding, forming dense hemispherical clumps, often more than a foot in diameter; often having a rather rough and ragged appearance, owing to irregularity of the branches and prominence of the verrucæ. Branches very variable in different examples, and often even in the same specimen; sometimes quite slender and not more than half an inch in breadth and varying in length from one to four inches, strongly compressed at the ends, or even tapering; more commonly much and irregularly subdivided, the ends enlarged and variously lobed, and often conspicuously verrucose at summit; sometimes the branches are stouter, less subdivided, compressed, one to two inches in breadth, three to six thick and three to five long, some with the ends verrucose, others scarcely so. The lateral verrucæ are generally distant, irregular, often elongated, rising very obliquely, or more or less appressed to the surface; in other cases small, but little prominent, or even subobsolete, especially below. Cells large, those at the summit much crowded, deep, separated by thin walls; the lateral ones mostly circular, not distant, usually with a prominent columella and twelve distinct septa, one of which is wider and joins the columella. Cœnenchyma between the lateral cells not very abundant, the surface thickly covered with very rough, coarse, spinulose grains.

The largest specimens are more than a foot in diameter.

Hawaiian Islands. Horace Mann; W. T. Brigham; J. D. Dana.

VAR. LATA Verrill.

Pocillopora plicata (*pars*) Dana, loc. cit.

One specimen (referred to *P. plicata* by Dana) has the branches stouter, .3 to .5 of an inch thick, and one to three inches or more broad, variously plicate, with the summits lobed and mostly naked, the smaller ones often verrucose, but in the characters of the lateral verrucæ and cells it scarcely differs from the large specimens of the ordinary variety. The lateral cells, however, generally have the septa less developed, and the surface between

them is not so strongly spinulose. But some of the outer branches have the stellate cells and rough surface of the ordinary form. The lateral verrucæ are rather distant, not very prominent, very oblique and somewhat appressed to the surface. The naked ends of the branches are covered with large, crowded, deep cells, separated by thin walls. The summits of the branches are separated by quite regular intervals, .3 to .4 of an inch broad. The specimen is about twelve inches broad and six high.

Hawaiian Islands. Rev. Mr. Baldwin, Museum of Yale College.

Pocillipora ligulata Dana.

Zoöphytes, p. 531, pl. 50, fig. 2, 2a; Edw. and Haime, Corall., III, p. 306.

The two original specimens, described by Prof. Dana, are in the Museum of Yale College.

In mode of branching and form of the verrucæ, they resemble some forms of *P. aspera*, though the branches are more regular and unusually divergent and distant. The longer branches are much compressed, thin and mostly dilated at the ends, .4 of an inch to 1.5 broad, and .3 to .4 thick. The larger branches have very cellular, naked summits; some of the younger branches are strongly verrucose at the end. The lateral verrucæ are well developed, not crowded, ascending, and mostly partially appressed to the surface. The lateral cells are rather distant, quite small, neatly stellate with twelve well-developed septa, one of which joins the small, prominent columella. The cœnenchyma is firm, between the cells covered with small, spinule-like grains. The specimens are about six inches high and broad.

Hawaiian Islands. Rev. Mr. Baldwin.

This species is evidently closely allied to *P. aspera*, from which it differs chiefly in its smaller and more distant cells, more fully developed septa, and the finer granulation of the cœnenchyma. With a larger series of specimens it might, perhaps, be possible to unite the two, but as yet I have observed no intermediate forms.

POCILLIPORA PLICATA Dana.

Pocillopora plicata (*pars*) Dana, Zoöph., p. 534, pl. 50, fig. 7, 7a to 7d.

A comparison of the original specimens shows that the typical form from the Feejees is quite different from the Hawaiian specimen described above (*P. aspera, var. lata*), although so similar in its branches and mode of growth that, without a direct comparison, especially of the cells, they would naturally be confounded, as was done by Prof. Dana. In this species the coral is very porous, and the cells are but little filled up below by solid matter, so that the transverse plates are often distinct through the whole length. The lateral cells are well separated, circular, rather large, stellate, having twelve unusually well developed septa and a small columella. The cœnenchyma between the cells is evenly covered with small spinules, much less rough than in *P. aspera*. The verrucæ are also more appressed and less numerous.

Feejee Islands. J. D. Dana. U. S. Expl. Expedition.

This species may best be distinguished from *P. aspera, var. lata* by the more distant cells, more highly developed septa, the finer and more even granulation of the surface, and the more porous texture.

POCILLIPORA FRONDOSA Verrill, sp. nov.

Corallum light and unusually porous, forming hemispherical clumps, consisting of numerous elongated, irregular, often crooked, compressed, frond-like branches, with expanded and variously lobed and plicate ends. The branches are from .3 of an inch to 1.5 broad, and .3 to .5 thick, except at the summits, which are scarcely .25. The verrucæ are nearly obsolete, both upon the sides and ends of the branches, being represented upon the lateral surfaces only by distant and slightly elevated, irregular prominences and low ridges, which are often wholly wanting. Cells large and deep, rather crowded, the spaces between seldom equal to half their diameter even

low down on the sides of the branches. Septa twelve, quite distinct, though narrow, one of them joining the columella, which is usually distinct, but low down in the cell; surface of cœnenchyma rough, thickly covered with rather coarse spinules.

Hawaiian Islands. W. T. Brigham.

This species is nearly allied to *P. aspera* by the structure of the cells and surface of the cœnenchyma, but is remarkable for its peculiar frond-like branches, destitute of distinct verrucæ. It is possible, however, that it may eventually prove to be only an extreme variety of that species. *P. informis* Dana differs in its irregular mode of growth and in the absence or rudimentary condition of the septa.

POCILLIPORA NOBILIS Verrill.

Pocillopora verrucosa (*pars*) Dana, Zoöph., p. 529, Plate 50, fig. 3, 3*a*, 1846 (*non* Lamarck; Edw. and Haime).

Pocillopora nobilis Verrill, Bulletin Mus. Comp. Zoölogy, p. 59, 1864.

Corallum firm and dense, forming large round-topped or hemispherical clumps, often a foot or even eighteen inches in diameter. Branches nearly equal in length, separated by regular intervals of .4 to .5 of an inch, elongated, often nearly round, .6 to .75 of an inch in diameter, regularly forking and not enlarged at the obtusely rounded ends; in other cases, even in the same specimen, dilated at the ends to a breadth of two or three inches and more or less plicated. Summits of the branches generally strongly verrucose, the verrucæ similar to those of the sides, but usually smaller and more crowded. Lateral verrucæ very numerous, rather crowded, the intervals being usually less than their diameter, small, regular, spreading obliquely, or even standing at right angles to the surface, tapering and somewhat rounded at the end, but angular and containing but few, quite large cells. Between the verrucæ the cells are rather large, numerous, usually less than half their own diameter apart. Septa but little developed, very narrow, usually indistinct, or wholly obsolete. Columella very small or wanting. Surface of the cœnenchyma regularly

covered with rather small spinuliform granules. Color of the unbleached coral deep yellowish brown.

Hawaiian Islands. J. D. Dana; Rev. Mr. Baldwin; A. Garret; Horace Mann; W. T. Brigham.

Var. TUBEROSA.

One specimen, which I refer with doubt to *P. nobilis*, is peculiar in having much larger and more prominent lateral verrucæ, which are rounded and often swollen at the end, or even obovate. Towards the base the verrucæ are less prominent and even hemispherical. The ends of the branches are enlarged, often lobed, and thickly covered with prominent verrucæ. The lateral cells are of medium size, not crowded, with the septa and columella but little developed. Surface between the cells closely granulous.

Hawaiian Islands. W. T. Brigham.

A species closely allied to *P. nobilis* occurs at Zanzibar, of which there is but one broken specimen in the Museum of Yale College. Its mode of growth and form of branches and verrucæ are the same, but it has smaller and less crowded cells, and the surface is much less granulous, with finer grains. The septa and columella are little developed, except in some of the cells near the base, where they become more distinct.

POCILLIPORA MÆANDRINA Dana.

Zoöph., p. 533, Plate 50, fig. 6, 6a, 6b, 1846.

The original specimen of this species is in the Museum of Yale College. It is closely allied to *P. nobilis*, but has mostly broad, plicated and convoluted, short, frond-like branches, with nearly naked summits. The verrucæ are rather small and closely crowded. The cells are somewhat smaller than is usual in *P. nobilis*, and the septa are in general very narrow, or scarcely apparent. The surface is finely granulous. Its resemblance to *P. nobilis* is so great as to suggest the possibility that it may be only an extreme variety of that species.

Hawaiian Islands. Rev. Mr. Baldwin.

POCILLIPORA ELONGATA Dana.

Zoöphytes, p. 531, Plate 59, fig. 4, 4b, 1846.

The original specimen of this fine species is also in the Museum of Yale College. It consists of very long, stout, furcate, rounded branches, about an inch in diameter, and often six inches or more long. The ends are obtuse, generally not much dilated, the longer ones without terminal verrucæ, the shorter ones with prominent ones. The lateral verrucæ are quite regularly scattered throughout, usually at distances greater than their diameter, prominent sub-conical, rounded, often standing nearly at right angles to the surface. The cells are neatly stellate, not large, well separated below, towards the ends of the branches becoming polygonal, separated often by a slight sulcus and a single row of spinules, and appearing sunken below the surface. The twelve septa are well developed, the six primaries often wider and thicker than the secondaries. The spaces between the septa are usually somewhat filled up and the edge of the cells is enlarged or excavate, giving them a sunken appearance. The collumella is small, but prominent and acute, often wanting. Surface of the cœnenchyma rough, with rather large, sharp, conical, spinule-like granules, which are evenly scattered, not crowded. Texture rather porous, the cells but little filled up below, and often show the transverse plates throughout. The whole height of the coral is about fifteen inches.

Ceylon. Rev. G. A. Apthorp.

POCILLIPORA CAPITATA Verrill.

Bulletin Mus. Comp. Zoölogy, p. 60, 1864.

Socorro Isles; Acapulco; La Paz; Pearl Islands, Panama Bay.

Var. POROSA, nov.

Corallum forming large rounded clumps, twelve to fifteen inches in diameter, with more or less elongated, subparallel, angular branches, which are from .25 to .75 of

an inch in diameter, and one to three long, often flattened and truncate at the end. Verrucæ large and prominent, ascending, the upper ones appressed, wholly obsolete on the ends of the larger branches. Lateral cells crowded, large and deep, with twelve to twenty-four distinct, but narrow and nearly equal septa, which are a little exsert and acute at summit. Cœnenchyma between the cells not abundant, often thin, the surface finely spinulose. Cells but little filled up below by solid deposits.

Near La Paz, Gulf of California. J. Pedersen.

POCILLIPORA LACERA Verrill, sp. nov.

Corallum forming irregular rounded clumps, six to eight inches in diameter and height, consisting of variously and irregularly divided, crooked branches, usually digitately lobed, or lacerately divided, at the ends. Branchlets short, irregular, often like elongated verrucæ. On the larger branches the verrucæ are small, irregular, and distant. Cells rather large, rounded, not crowded; sometimes with twelve to twenty-four very narrow septa, which are often abortive. Columella rudimentary or wanting. Cœnenchyma abundant, firm, the surface finely and evenly spinulose.

Acajutla and Pearl Islands. F. H. Bradley.

SERIATOPORA sp.

A species allied to *S. subulata*, represented only by a fragment. The branches are slender, coalescent and reticulated. The cells are small and in series; borders scarcely prominent.

Groper Shoal, Coral Sea. Dr. Wm. Stimpson.

Note on Gorgonidæ. — Having recently had an opportunity to study a large series of spicula, many of them prepared from authentic and original specimens in various European Museums, and sent by Dr. Kölliker, I have found it necessary to change the names of several genera and species (see Amer. Journal Science, Nov., 1869, p. 419). The names of species described in this Synopsis, which have been changed, stand as follows: —

Eunicella venosa Verrill = *Gorgonia venosa* Val.
E. palma Verrill = *G. albicans* Köll.
Leptogorgia flammea V. = *Lophogorgia palma* E. and H. (non Pallas).
Leptogorgia cuspidata V. = *Litigorgia cuspidata* V.

GEOGRAPHICAL LISTS

OF THE

SPECIES ENUMERATED IN THIS SYNOPSIS.

MADEIRA.

Eunicella venosa V.
Comactis flagellifera E. & H.

CAPE OF GOOD HOPE.

Euplexaura Capensis V.
Leptogorgia flammea V.
Eunicella palma V.
Eunephthya thyrsoidea V. (False Bay).
Balanophyllia Capensis V. (Simon's Bay).
Halocampa Stimpsonii V.
Halocampa Capensis V.
Cereus Stimpsonii V.
Corynactis annulata V. (False Bay).

PORT JACKSON, AUSTRALIA.

Plesiastræa Urvillei E. and H.
Metridium, sp.

CORAL SEA.

Madrepora globiceps (?) Dana. (Groper Shoal).
Turbinaria, sp.
Seriatopora, sp.

TAHITI.

Madrepora hebes Dana. (Loo Choo?).
Madrepora tubicinaria Dana.

FEEJEES.

Pocillipora Danæ V.
Pocillipora plicata Dana.
Fungia lacera V.
Pachyseris monticulosa V.

EBON ISLAND.

Paracyathus Ebonensis Verrill.

HAWAIIAN ISLANDS.

Montipora patula V.
Cœnopsammia Mannii V.
Pocillipora cæspitosa Dana.
P. aspera V. and *var.* lata V.
P. ligulata Dana.
P. frondosa V.
P. nobilis V. and *var.* tuberosa V.
P. informis Dana.
P. mæandrina Dana.
(?) Cœlastræa tenuis V.
(?) Astræa Hombronii V.
(?) Astræa rudis V.
Leptastræa stellulata V.
Cyphastræa ocellina E. and H.

Loo Choo Islands.

Spongodes gracilis V.
Telesto (?) nodosa V.
Madrepora turgida V.
Madrepora microphthalma V.
Montipora poritiformis V.
Montipora lichenoides V.
(?) Porites tenuis V.
Psammocora parvistella V.
Dendrophyllia Cecilliana E. and H.
Pocillipora gracilis V.
Plesiastræa indurata V.
Galaxea fascicularis (?) Oken.
Fungia papillosa V.
Pavonia complanata V.
Stephanoseris lamellosa V.
Zoanthus, sp.
Zoanthus, sp.
Palythoa, sp.
Sagartia (?) Napensis V.

Bonin Islands.

Tubipora rubeola (?) Q. and G.
Madrepora pumila V.
Montipora rigida V.
Euphyllia undulata V.
Cerianthus Stimpsonii V.
Paranthea minuta V.
Phellia (Paraphellia) inequalis V.
Phellia, sp.
Sagartia, sp.
Amphiactis orientalis V.
Discostoma fungiforme V.

Ousima.

Madrepora teres V.
Madrepora prolixa V.
(?) Madrepora striata V. (Loo Choo?).
(?) Pavonia foliosa V. (Loo Choo?).
Diaseris pulchella V.
Phellia clavata V.
Phellia, sp.
Cereus, sp.
Sagartia nigropunctata V.

East Indies and Ceylon.

Madrepora nobilis Dana. (Gaspar Straits).
Montipora exesa V. (Gaspar Str.).
Montipora foliosa E. and H. (Ceylon?).
Pocillipora elongata Dana. (Ceylon).
Pocillipora brevicornis Lam. (Ceylon).
Heterocyathus alternata V. (Gaspar Straits).
Stephanoseris sulcata V. (Ceylon).
Stephanactis Indica V. (Gaspar Straits).

Hong Kong and China Sea.

Pteromorpha expansa V.
Virgularia pusilla V.
Veretillum Stimpsonii V. (H. K. and China Sea).
Kophobelemnon clavatum V.
Muricea flexuosa V.
Astrogorgia Sinensis V.
Anthogorgia divaricata V.
Echinomuricea coccinea V.
Juncella levis V.
Parisis laxa V. (H. K. and Formosa).
Alcyonium?
Nephthya aurantiaca V. (23° N. Lat.).
Spongodes gigantea V.
Spongodes capitata V.
Anthelia lineata St.
Telesto ramiculosa V.
Sarcodictyon, sp.
Madrepora tumida V.
Porites, sp.
Turbinaria Sinensis V.
Dendrophyllia gracilis E. and H.
Pachypsammia valida V.
Goniastræa aspera V.
Cœloria Sinensis E. and H.
Astræa ordinata V.
Prionastræa Chinensis V.
Paracyathus porcellana V.

Cerianthus orientalis V.
Halocampa brevicornis V.
Actinia? timida V.
Paranthea armata V.
Ammonactis rubricollum V.
Phellia collaris V.
Cereus Sinensis V.
Sagartia Paguri V. (23° N. Lat.).
Sagartia lineata V.
Cancrisocia expansa Stimpson.
Bunodes inornata V.
Physactis multicolor V.
Anthopleura Stimpsonii V.
Homactis rupicola V.

JAPAN AND NORTH CHINA SEA.

Mopsella Japonica V.
Sarcophytum agaricum V. (Kag. Bay).
Madrepora arbuscula? Dana. (Kag. Bay).
Eupsammia Stimpsoniana V. (25 fathoms).
Ctenactis, sp. (young).
Stephanoseris Japonica V. (Kag. Bay).
Edwardsia cretata V. (Kag. Bay).
Sagartia radiata V. (Kag. Bay).
Bunodes Japonica V. (Hak. Bay).
Urticina coccinea V. (Kag. Bay).
Anthopleura, sp. (Simoda).

OCHOTSK SEA.

Veretillum baculatum V. (25 fathoms).
Alcyonium? (Lobularia Verrilli Gray).

BEHRING'S STRAITS AND ARCTIC AMERICA.

Primnoa compressa V. (Aleut. I.).
Alcyonium rubiforme Dana.
Phellia arctica V. (Arctic Ocean).
Urticina crassicornis Ehr.

PUGET SOUND AND CALIFORNIA.

Ptilosarcus Gurneyi Gray. (Puget Sound).
Metridium fimbriatum V. (Pug. Sd. and San Francisco).

PANAMA, LOWER CALIFORNIA AND GULF.

Leioptilum undulatum V. (Gulf).
Leptogorgia cuspidata V. (Cape St. Lucas).
Allopora Californica V.
Pocillipora capitata V. *var.* porosa V.
P. lacera V. (Panama).

WEST INDIES.

Phellia Vernonia V.
Phellia Americana V.
Phellia cricoides V.
Phellia Coreopsis V.

UNKNOWN.

Turbinaria dichotoma V. (Bonin or Loo Choo?).
Flabellum, sp.
Fungia, sp.

EXPLANATION OF PLATES.

PLATE 1.

Figure 1. EDWARDSIA CRETATA Stimpson, much enlarged; 1 *a*, one of the tentacles, showing arrangement of color-bands.

Figure 2. PHELLIA COLLARIS Verrill, natural size; 2 *a*, one of the tentacles enlarged.

Figure 3. PHELLIA CLAVATA Verrill, natural size; 3 *a*, one of the inner tentacles enlarged; 3 *b*, one of the outer tentacles, showing the arrangement of colors.

Figure 4. PHYSACTIS MULTICOLOR Verrill, natural size; 4 *c*, profile view of mouth and two of the tentacles.

Figure 5. BUNODES INORNATA Verrill, view of the disk from above; 4 *a*, one of the outer tentacles; 4 *b*, one of the inner ones.

Figure 6. URTICINA COCCINEA Verrill, natural size.

Figure 7. DISCOSTOMA FUNGIFORME Verrill, natural size.

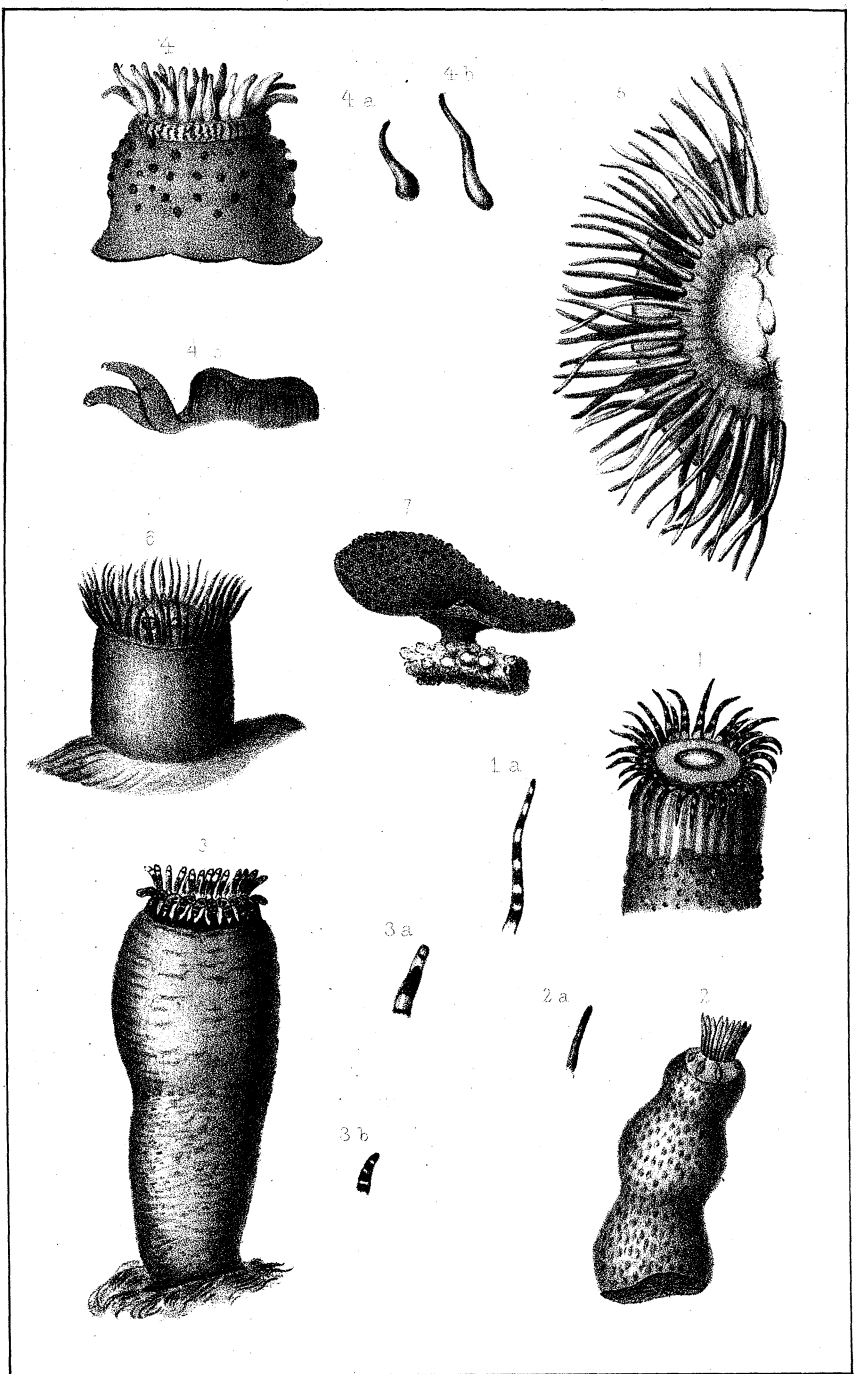
PLATE 2.

Figure 1. CANCRISOCIA EXPANSA Stimpson, natural size in its normal position on the carapax of *Dorippe;* 1 *a*, enlarged view of the mouth and part of the disk and tentacles, as seen from above.

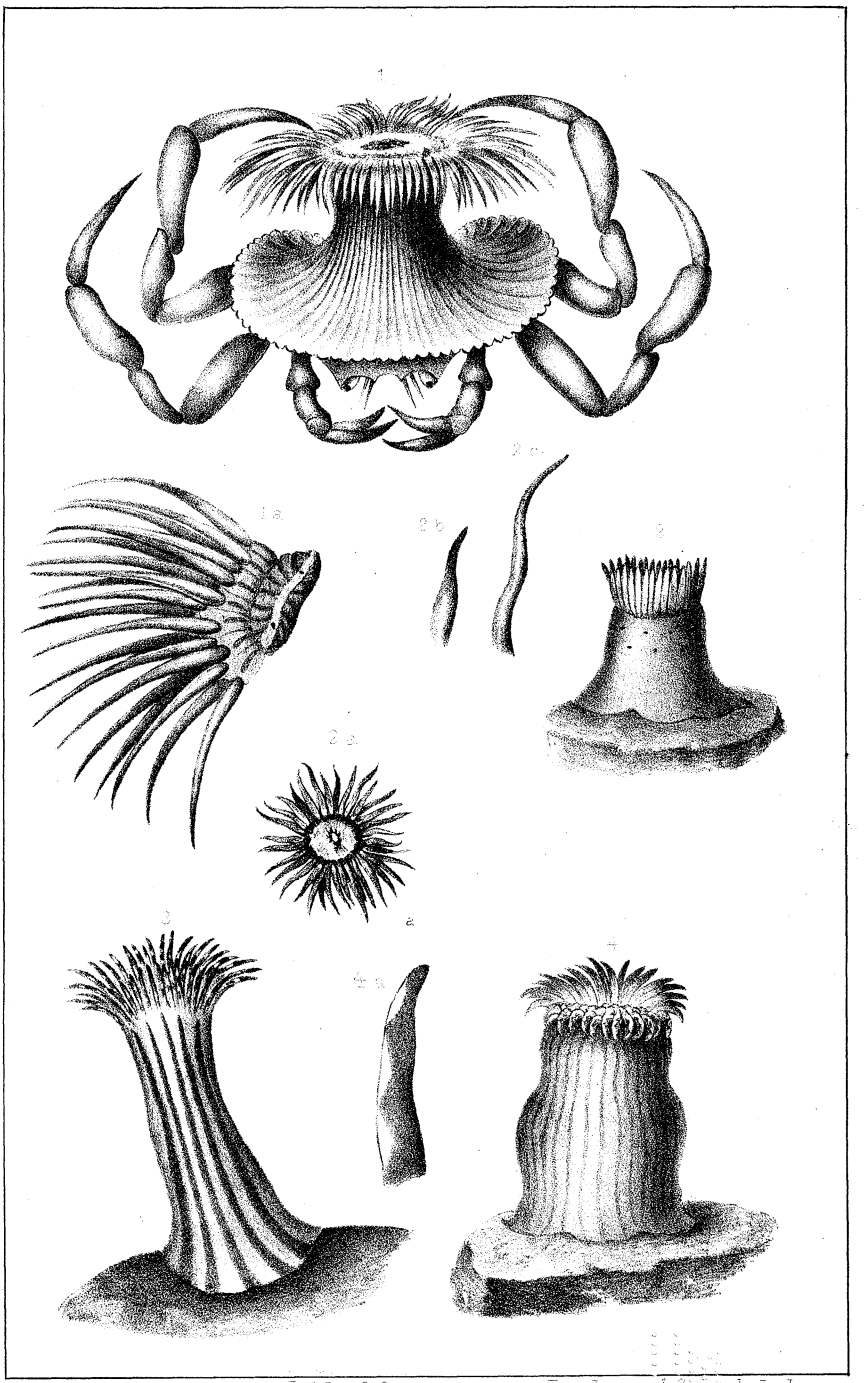
Figure 2. SAGARTIA NIGROPUNCTATA Verrill, natural size; 2 *a*, view of the disk and tentacles from above, natural size; *a*, the long, odd tentacle in the plane of the longer axis of the mouth; 2 *b*, one of the shorter tentacles, enlarged; 2 *c*, one of the longer inner tentacles.

Figure 3. CEREUS SINENSIS Verrill, natural size.

Figure 4. SAGARTIA (?) NAPENSIS, Verrill, natural size; 4 *a*, a tentacle much enlarged.



W. Stimpson, from nature L. Schierholtz, on stone Punderson & Crisand, Lith.



W Stimpson, from nature L Schiebolz on stone Funderson & Quisard, Lith

V. *Flora of the Hawaiian Islands.*

By Horace Mann.

[Concluded from vol. v, p. 248.]

1. PAPAYA Tourn. [Milikana Hei.]

Genus (which, with another, forms the small tribe of *Papayaceæ*) with unisexual flowers, differing from the rest of the order in that the flowers are destitute of a crown, the stamens distinct and in 2 series, inserted on the throat of the corolla; the ovary sometimes spuriously 5-celled; and the species being small trees with milky juice. Male flowers: Calyx small, 5-toothed. Corolla hypogynous, funnel-shaped, limb 5-lobed. The 5 stamens opposite the corolla lobes sessile, the 5 alternate ones with short filaments. Female flowers: Calyx as in the male. Petals 5, linear-oblong, erect, deciduous. Style very short; stigma dilated radiately 5-lobed or simple. Fruit baccate, 1-celled, with a firm rind, pulpy inside.—Soft-wooded trees, with palmately many-lobed or rarely entire leaves, in terminal clusters. Peduncles axillary, the male one many-flowered, racemed or corymbed, the female ones few-flowered.

A small tropical American genus.

1. Papaya vulgaris, *D C.* (*Enum. No.* 147.) A small tree, usually with a simple erect trunk, but sometimes branching; the trunk becoming hollow with age and containing a large quantity of fluid. Leaves clustered at the summit of the trunk or branches, petioled, 1° more or less, in diameter, palmately many-lobed. Flowers white or whitish. Fruit large, orange-yellow, edible.

Much planted and now run wild in many places. Commonly called *Papaya*, *Pawpaw* or *Papaw*. Native of tropical America, but common now in most tropical countries.

Order XXXV. CUCURBITACÆ.

Tender or succulent herbs, climbing by tendrils; with alternate, palmately veined, or lobed, rough leaves, and monœcious (in all our species) or dicœcious flowers. Calyx of 4 or 5 (rarely 6) sepals, united into a tube, and in the fertile flowers adherent to the ovary. Petals as many as sepals, commonly more or less united into a monopetalous corolla, which coheres with the calyx. Stamens 5 or 3, or rather two and a half, *i. e.* two with 2-celled anthers, and one with a 1-celled anther, inserted into the base of the corolla or calyx, either distinct or

variously united by their filaments, and long, sinuous or contorted anthers. Ovary 1–5-celled; the thick and fleshy placentæ often filling the cells, or diverging before or after reaching the axis, and carried back so as to reach the walls of the pericarp, sometimes manifestly parietal; the dissepiments often disappearing during its growth, sometimes only one-ovuled from the top; stigmas thick, dilated or fringed. Fruit (pepo) usually fleshy, with a hard rind, sometimes membranous. Seeds mostly flat, with no albumen. Embryo straight; cotyledons foliaceous.

The species *Cucurbita pepo*, the Pumpkin, Winter-squash, &c.; *C. maxima*, the squash; *Citrullus vulgaris*, the Watermelon; *Cucumis melo*, the Musk-melon; and *C. sativus*, the Cucumber, are much cultivated for their edible fruits.

1. LAGENARIA Ser. [Ipu.]

Flowers solitary. Male flowers long peduncled. Calyx-tube campanulate or funnel-shaped, with 5 lanceolate or subulate, spreading lobes. Petals 5, free, spreading, obcordate or obovate, retuse, mucronate. Stamens inserted on the calyx-tube, the filaments free; anthers slightly cohering, the cells tortuous. Ovary wanting. Female flowers short peduncled. Calyx and corolla as in the male. Stamens, none. Ovary oblong, ovoid, or cylindrical, with 3 placentæ; style short, thick, with 3 two-lobed stigmas; ovules indefinite, horizontal. Fruit of various shapes, woody, indehiscent, with a soggy meat. Seeds compressed, margined.—Climbing or trailing pubescent herbs, with ovate- or reniform-cordate, or nearly orbicular, large, dentate leaves, the petioles with two glands near the apex. Tendrils bifid. Flowers large, white.

Species 1, native of tropical Asia and Africa, cultivated throughout the tropics.

1. LAGENARIA VULGARIS *Ser.* (*Enum. No.* 140.)

2. CUCURBITA Linn. [Ipu.]

Flowers solitary. Male flowers: Calyx-tube campanulate, 5-lobed. Corolla campanulate, 5-cleft. Stamens 3, inserted on the base of the calyx; filaments free; anthers linear, compacted in a head, the elongated cells flexuose. Ovary wanting. Female flowers: Calyx and corolla as in the male. Rudiments of stamens 3. Ovary oblong, with 3 placentæ; style short, with 3 two-lobed or two cleft stigmas; ovules numerous, horizontal. Fruit fleshy, usually with a rind, indehiscent. Seeds ovate or oblong, flat.—Herbs with annual or perennial roots, cordate and lobed large leaves, 2–many-cleft tendrils, and large yellow flowers. The fruit often gigantic.

A small genus, native of tropical regions.

1. C. MAXIMA *Duch.* (*Enum. No.* 141.) Stems long, spreading, or

climbing by means of tendrils. Leaves cordate, roughened, or hispid petioles. Calyx-tube obovate, constricted in the throat. Fruit globose, large, yellow or greenish or reddish.

Cultivated from time immemorial by the natives; probably introduced. Native country impossible to designate, as this species has been cultivated by man in most all tropical regions for so long a time.

3. SICYOS Linn. [Palunu.]

Male flowers racemed or corymbed. Calyx-tube very broadly campanulate, with 5 small teeth, or entire. Corolla rotate, 5-parted, the segments triangular-ovate and whole confluent with the calyx. Stamens confluent by the base of their filaments in a short column; anthers 2–5, sessile at the apex of the column, connate in a head or more or less free, the cell curved or very flexuose. Ovary wanting. Female flowers usually in the same raceme as the male, at the apex of a more or less elongated peduncle, rarely solitary. Calyx above the ovary and corolla as in the male. Stamens none. Ovary ovate or subulate, sometimes long-beaked, setose or aculeate, or rarely smooth, 1-celled; style short, with 3 stigmas; ovule one, hanging from the apex of the cell. Fruit leathery or somewhat woody, angled. Seed with a membranaceous testa. — Glabrous or pubescent-scabrous, climbing or prostrate herbs, with angled, lobed, or cleft membranous leaves; 3-cleft tendrils, minute flowers, and small fruit. — The Hawaiian species belong to the section or

Subgenus SICYOCARYA. Fruit ovate-pyramidal or oblong, 4–6- (rarely 3-) angled, unarmed, and more or less beaked; the pericarp much thickened. Anthers 2–5, contorted and adnate at their bases; the connective narrow.

A small genus, mostly found in the hot parts of America, the subgenus peculiar to the Hawaiian Islands.

Leaves nearly or quite glabrous, large; fruit more than 3 lines long.
- Leaves lobed, cordate at the base. Male flowers 1 or 2 lines in diameter. . . . . *S. pachycarpus.*
- Leaves barely lobed. Male panicles umbellate or a long peduncle; flowers 5 lines in diameter when expanded. . . . . *S. macrophyllus.*
- Leaves barely or very deeply lobed. Male panicles long pedunculed, 3-branched; flowers 3 or more lines in diameter. . . *S. cucumerinus.*

Leaves hispid or papillose scabrous, especially beneath, small. Flowers very small, as are the fruits which are 2 lines long. . . . *S. microcarpus.*

1. S. (SICYOCARYA) PACHYCARPUS *Hook and Arn.* (*Enum. No.* 142.) Stems slender, angled, nearly glabrous, sometimes with glandular-tipped hairs. Leaves membranaceous, 3′–5′ in diameter, rounded and cordate-angled, 3–7-lobed, the terminal lobe the longest; the margin of the leaf remotely denticulate, the lower surface somewhat papillose-scabrous; petioles 1′–2′ long. Male flowers small, a line or two in diameter, in racemose, simple or compoundly branched panicles. Female flowers numerous in a small head at the summit of the pedun-

cle. Fruit ovate-pyramidal, several usually ripening in the head, closely sessile, 5″–7″ long, 5–6-angled, pointed with a slender beak.

Kaala mountains and district of Waianæ, Oahu, mountains of West Maui.

2. S. (SICYOCARYA) MACROPHYLLUS *Gray*. (*Enum. No.* 143.) Stem strongly angled, pubescent or quite glabrous. Leaves rounded-cordate, slightly or more deeply 3–5-lobed, often large, 3′–10′ in diameter, membranaceous, glabrous or softly puberulent underneath, not scabrous, the margin sharply toothed with short callous-tipped teeth; petioles 3′ long. Male panicles umbellate at the summit of a long and slender peduncle (5′–7′ long) glandular-puberulent as are the flower buds, on pedicels 4″–5″ long, which are often fascicled. The perianth becoming 5″ in diameter when expanded. Female flowers clustered at the summit of a short peduncle. Fruit ovate, 5–6-angled, nearly glabrous, conspicuously beaked.

Forests of Mauna Kea, Hawaii.

3. S. (SICYOCARYA) CUCUMERINUS *Gray*. (*Enum. No.* 144.) Stem strongly angled, glabrous. Leaves broadly cordate, or sometimes almost kidney-shaped, undivided and scarcely lobed 3½′–6½′ in diameter, glabrous, membranaceous, the margin sharply denticulate. Male flowers in a three-branched racemose panicle on a short or long (2′–4′) peduncle, the perianth 5-cleft to the middle, about 4″ broad when expanded. Female flowers on the summit of a shorter peduncle; the ripe ovaries a few together at the summit of the peduncle, sessile, oblong, an inch long, 5–6-angled but not sharply so, and with a long beak which often breaks off. One *variety* presents leaves which are slightly lobed, and another *variety* leaves which are palmately 3-lobed, nearly to the base, the lobes being again more or less lobed, and all sharply toothed, and sometimes scabrous.

Hawaii, in forests on Mauna Kea; the *varieties* also from the mountains above Waimea, Kauai.

4. S. (SICYOCARYA) MICROCARPUS *H. Mann*. (*Enum. No.* 165.) Stem strongly angled, glabrous. Leaves papillose-scabrous above, hispid below, on slender petioles of more than their own length, 1′–2½′ in diameter, angled, deeply cordate at the base, thin membranaceous. Male panicles three-branched, on slender peduncles exceeding the leaves in length, flowers very small. Female flowers 30–40 in a head on a peduncle only 3″ or 4″ long; the fruits 2″ long, sessile, and crowded, several angled by mutual pressure, short-beaked.

Oahu.

ORDER XXXVI. BEGONIACEÆ.

Succulent herbs or under shrubs, with scattered or two-ranked, or rarely somewhat verticillate entire, lobed, or digitately-parted, inæqui-

lateral leaves, with 2 free, usually caducous stipules, and axillary, peduncled, bracted cymes, bearing one or both sexes of flowers. Flowers monœcious, asymmetrical, white, red or yellow, and very showy. Male flowers: Perianth segments 2 or more, the exterior usually 2, sepaloid, opposite, valvate, the interior petaloid, imbricated, or none. Stamens indefinite; filaments free or connate. Ovary wanting. Female flowers: Perianth segments 2–5, rarely more, variously disposed. Ovary more or less inferior, 1–many-celled, but usually 3-celled and 3-angled. Styles 2–5, more or less joined, usually 2-cleft. Ovules very numerous. Fruit capsular or berry-like. Seeds minute, with thin or no albumen.

Many species of *Begonia*,—in which the male flowers have the 2 outer perianth-leaves sepaloid, the 2 inner petaloid, or rarely more than 2 or wanting, the stamens indefinite, free or monadelphous; female flowers with usually 6 leaves to the perianth, of which the 2 outer larger ones are sepaloid, a usually 3-celled inferior ovary, with as many 2-many-cleft styles; the placentæ usually in the axis of ovary; fruit usually capsular, and septicidally or loculicidally dehiscent,—are cultivated for their showy flowers and bracts.

1. HILLEBRANDIA Oliver.

Male flowers: Sepals 5, nearly equal, broadly ovate, acute. Petals 5, alternate with the sepals, small, spathulate, and hooded. Stamens indefinite, free. Female flowers: Calyx tube hemispherical, wingless, adnate to the ovary, with a 5-lobed limb. Petals as in male flowers. Stamens represented by numerous minute stipitate perigynous glands. Ovary open at the free apex, imperfectly 5-celled, with five bilamellar placentæ, projecting into the cells; styles 5, opposite the calyx-lobes, 2-cleft. Capsule membranaceous, wingless, dehiscing by a broad opening at the top between the styles. — A branched, hairy, succulent herb, with oblique-cordate-rotund irregularly 5–9-lobed sharply serrate petioled leaves, and many bracted, peduncled cymes, bearing both sexes of flowers.

Genus of one species, peculiar to the Hawaiian Islands.

1. HILLEBRANDIA SANDWICENSIS *Oliver*. (*Enum. No.* 147.) A large herb 3°–6° high.

Valleys behind Lahaina, West Maui, where it was first discovered by Mr. Dwight Baldwin. Waioli Valley Kauai. Mountain above Waimea, Kauai, often on cliffs by the side of cascades or on the moist banks of brooks high in the mountains.

ORDER XXXVII. UMBELLIFERÆ.

Herbs, with hollow stems, and alternate, dissected leaves, with the petioles sheathing or dilated at the base. Flowers in simple or mostly compound umbels, which are occasionally contracted into a kind of head. Calyx entirely coherent with the surface of the dicarpellary

ovary; its limb reduced to a mere border, or to 5 small teeth. Petals 5, valvate in æstivation, inserted, with the 5 stamens, on a disk which crowns the ovary; their points inflexed. Styles 2; their bases often united and thickened, forming a stylopodium. Fruit dry, a *cremocarp*, consisting of 2 united carpels, at maturity separable from each other, and often from a slender axis (*carpophore*), into two achenia, or *mericarps:* the face by which these cohere is called the *commissure:* they are marked with a definite number of *ribs* (juga), which are sometimes produced into wings: the intervening spaces (intervals), as well as the *commissure*, sometimes contain canals or receptacles of volatile oil, called *vittæ*. Embryo minute, in hard or corneous albumen.

Aquatic herb, with peltate or shield-shaped leaves, ... 1. HYDROCOTYLE.
Land herbs.
Bristles of the fruit hooked; leaves palmately-lobed or parted, 2. SANICULA.
Bristles of the fruit barbed; leaves twice pinnate, ... 4. DAUCUS.
Fruit not bristly, ... 3. FŒNICULUM.

1. HYDROCOTYLE Tourn. [Poe, Pohi.]

Calyx-teeth obsolete. Fruit flattened laterally, orbicular or shield-shaped, the carpels 5-ribbed, two of the ribs enlarged and often forming a thickened margin: oil tubes none. — Low and smooth marsh perennials, with slender stems creeping or rooting in the mud, and round shield-shaped or kidney-form leaves. Flowers small, white, in simple umbels or clusters, which are either single or proliferous.

A considerable genus, dispersed over the greater part of the globe.

1. H. INTERRUPTA *Muhli.* (*Enum. No.* 149.) Leaves peltate in the middle, orbicular crenate; peduncles about the length of the leaves, bearing clusters of few and sessile flowers interruptedly along its length; fruit broader than long, notched at the base.

In marshy and wet places; frequent near two ponds. Also native of North America.

2. SANICULA.

Calyx teeth manifest, persistent. Fruit globular; the carpels not separating spontaneously, ribless, thickly clothed with hooked prickles, each with 5 oil-tubes. — Perennial herbs, with palmately-lobed or parted leaves, those from the root long petioled. Umbels irregular or compound, the flowers capitate in the umbellets, perfect, and with staminate ones intermixed. Involucre and involucels few-leaved.

A small genus, mostly found in North Temperate regions.

1. S. SANDWICENSIS *Gray.* (*Enum. No.* 150.) Root fusiform, 6′–10′ long. Stem 1°–2° high, angular glabrous, as is the whole plant. Leaves roundish, 2′ in diameter, palmately 3–5-parted or almost

divided; the cuneate segments 2-3-cleft and incised, sometimes 5-cleft. The lobes oblong, or of the upper leaves, lanceolate or oblong-linear, very sharply and incisely serrate, with bristle-pointed teeth; the uppermost leaves sessile; involucres two-leaved. Umbels of 3-5 rays which are longer than the involucels. Umbellets $2\frac{1}{2}''$ in diameter, exceeding the oblong-lanceolate and entire divisions of the involucel, globular, densely many-flowered. Flowers yellow, the male flowers short pedicelled and exterior; the female flowers sessile; their filiform styles exserted and recurved. Fruit ovate, $2''$ long, echinate throughout with long and stout hooked prickles.

Hawaii and East Maui, on the mountains.

3. FŒNICULUM Adans.

Calyx teeth obsolete. Petals entire. Fruit oblong, somewhat cylindrical; the carpels rounded on the back; the 5 primary ribs thick and prominent, and the oil-tubes under the intervening furrows. — Biennial or perennial glabrous herbs, with pinnately decompound leaves, the segments linear; compound umbels with no involucres and yellowish flowers.

A small genus; one or more of the species now widely dispersed.

FŒNICULUM VULGARE *Gærtn.* Stock perennial. Stems erect, branched, 2°-3° or more high. Leaves 3 or 4 times pinnate, with very narrow linear or subulate segments. Umbels of 15, 20 or more rays. Fruit about 3 lines long, the oil-tubes very conspicuous.

Abundantly introduced and naturalized in many places.

4. DAUCUS Linn.

Calyx 5-toothed. Corolla irregular. Fruit ovoid or oblong; the carpels scarcely flattened on the back, with 5 primary slender bristly ribs, two of them on the inner face, also with 4 equal and more or less winged secondary ones, each bearing a single row of slender bristly prickles: an oil-tube under each of these ribs. — Biennials, with finely 2-3-pinnate or pinnatifid leaves, cleft involucres, and concave umbels, dense in fruit.

A small genus mostly of the warm parts of America, and the Mediterranean region.

DAUCUS PUSILLUS *Michx.* (*Enum No.* 151.) Annual: stem rough with reflexed hairs; leaves twice pinnate, with the divisions linear. Umbels long-peduncled. Bristles of the fruit barbed.

Highlands of Hawaii, probably introduced. Native in the warm parts of North America.

Leaves (pinnate, with 7 large ovate leaflets) only, of a large umbelliferous plant, were gathered on the mountains of Kauai, by the Naturalists of the United States South Pacific Exploring Expedition.

NOTE.

After a delay of about two years we find that it will be impossible to complete Mr. Mann's "Flora of the Hawaiian Islands" in this volume, as we anticipated doing at the time of the decease of our lamented friend. We are therefore obliged to close the "Flora" at the end of the Umbelliferæ.

While regretting that the work is not to appear in a complete form in the "Communications of the Institute," we have the satisfaction of announcing that the Government of the Hawaiian Islands, appreciating Mr. Mann's labors in developing the Flora of the kingdom, have made an appropriation for the publication of the completed work with illustrations. At Mr. Mann's death the manuscript of the monopetalous orders was nearly ready for the press. This was placed in the hands of William T. Brigham, Esq., Mr. Mann's companion in Hawaiian Explorations, who has since nearly completed the phænogamous portion of the Flora. — EDITOR.

VI. *Notes on the Birds of Minnesota.*

By T. Martin Trippe.

The following notes on the Birds of Minnesota were taken during the past year (1870) while the author was engaged in various railroad surveys in that State. They do not profess to contain a complete list of the avi-fauna of that region; indeed, probably not more than three-fifths of the species are mentioned, — and are merely the result of such facts as came under my observation while at work in the field.

The district embraced extends between Otter-tail Lake and Lake Mille Lacs. The period of observation was between April and December.

Although four hundred miles further north, most of the migratory species arrive in this region nearly as early as they do in the vicinity of New York. The Robin, Bluebird, and others that migrate on the appearance of spring, appear, it is true, some weeks later; but the great mass of birds, the Warblers, Flycatchers, Thrushes, etc., arrive nearly or quite as early. The season, indeed, is quite as far advanced here by the 10th of May, as it is in the neighborhood of New York.

The nomenclature is from Audubon's Synopsis.

1. *Cathartes aura.* Abundant; breeds. The Turkey Buzzard usually selects the hollow, prostrate trunk of a large tree for its nest. I found young birds scarcely fledged as late as the 29th of July. There are usually two young; occasionally but one. This bird is capable of withstanding considerable cold. I saw it on the 24th of October, and again on the 8th of December.
2. *Buteo borealis.* Not common.
3. *B. lagopus.* Seen a few times in the fall.
4. *Haliaëtus leucocephalus.* Rather common, especially in winter.
5. *Pandion haliaëtus.* I saw but a single pair of these birds. They had fixed their nest in the top of a tall, dead pine on the banks of the Mississippi; and at that date, June 30th, the young were just hatched.
6. *Nauclerus furcatus.* Rather common, especially in the immediate vicinity of the Mississippi. It arrives early in June, and remains all summer. I saw this bird 30 miles north of Mille Lac, — lat. 47°.
7. *Falco peregrinus.* Seen a few times in autumn.
8. *F. sparverius.* Common; breeds. Found hatching in May.
9. *Circus cyaneus.* Common; breeds.
10. *Ulula Tengmalmii?* This, or a very similar species, was not unusual in the spruce and hemlock woods.

11. *Syrnium nebulosum.* Not abundant.

12. *Bubo Virginianus.* Not common.

13. *Caprimulgus vociferus.* Very abundant. It arrives in the first week of May, and was seen as late as the 21st of September.

14. *Chordeiles Virginianus.* Abundant. Arrives about the middle of May, and leaves towards the close of August.

15. *Chætura pelasgia.* Not common.

16. *Hirundo purpurea.* Uncommon.

17. *H. bicolor.* Seen in great numbers in May, near the Leaf River, but not observed elsewhere.

18. *H. riparia.* Very common.

19. *Muscicapa tyrannus.* Very abundant. Arrives in the middle of May.

20. *Tyrannula minima?* Abundant. Possibly an allied species, though I think not. I saw also another species of *Tyrannula* which I took to be

21. *T. flaviventris*, though I might have been wrong. It was not very common.

22. *Muscicapa virens.* Common, especially near the Mississippi.

23. *M. ruticilla.* Seen once or twice in May.

24. *Sylvicola coronata.* Abundant. It appears towards the close of April, remaining for two or three weeks, then passing north. It reappears in the latter part of August, on its southward migration.

25. *S. Pennsylvanica.* Rather rare; breeds.

26. *S. pinus?* Not common; breeds.

27. *S. æstiva.* Rare.

28. *S. petechia.* Abundant in the early part of May; goes further north to breed.

29. *S. virens.* Common; breeds.

30. *S. Americana.* Rare. Seen only towards the latter part of August.

31. *S. Canadensis.* Not common; breeds.

32. *Trichas Marilandica.* Abundant. Appears in the middle of May.

33. *T. Philadelphia.* Abundant; breeds. The Mourning Warbler haunts the edges of tamarack swamps, and the damp thickets that adjoin them. I made frequent search for its nest, but was not fortunate enough to find it, though I repeatedly saw the old birds feeding the young in the latter part of June and early in July. They are similar in their habits to the Maryland Yellow-throat, but are not so exclusively devoted to thickets and underbrush, frequently ascending to the tops of the tamaracks, for which they show a great predilection. The Mourning Warbler has a very agreeable song, very similar to that of the Water Thrush, *Seiurus Novæboracensis.*

34. *Mniotilta varia.* Common.

35. *Certhia familiaris.* Not very common; breeds in the tamarack swamps. A nest found May 9th, contained six eggs on which the bird had just begun to set. They were white with a very faint tinge of buff, and sprinkled with small spots of reddish brown, which are most numerous towards the larger end.

36. *Troglodytes Bewickii.* Common; breeds. I found a nest with seven young just hatched, on the 3d of July. The song of this bird is very similar to that of the House Wren, while in its habits it resembles the Winter Wren.

37. *T. œdon.* Possibly the preceding species was mistaken for this. The different Wrens are so similar in color and general appearance that it is very difficult to distinguish them except by close examination.

38. *T. hyemalis.* Not common; breeds.

39. *T. palustris.* Abundant; breeds. If not this species, one that agrees very closely with it in notes, habits and general appearance.

40. *T. stellaris.* Abundant; breeds.

41. *Parus atricapillus.* Abundant.

42. *Regulus satrapus.* Uncommon; does not breed.

43. *R. calendulus.* Uncommon; does not breed.

44. *Sialia sialis.* Abundant. The Bluebird breeds in great numbers in the interminable pine barrens and tamarack windfalls that extend over the greater portion of the northern half of Minnesota.

45. *Orpheus rufus.* Common.

46. *Turdus migratorius.* Rather common. It frequents the pine barrens, where it finds ample facilities for nesting. It avoids the tamarack regions.

47. *T. mustelinus.* Common. The cool, damp woods adjoining the tamarack marshes, are a favorite resort of this and other species of Thrushes.

48. *T. Wilsonii.* Common; breeds.

49. *T. Swainsonii.* Rather rare. Does not breed.

50. *T. solitarius.* Common. Does not breed.

51. *Seiurus aurocapillus.* Common.

52. *Anthus Ludovicianus.* Common, appearing by the first of September.

53. *Alauda alpestris.* Common.

54. *Plectrophanes Lapponicus.* Abundant. The Lapland Longspur arrives about the middle of September, and remains until December, when it moves further south, its place being supplied by the Snow Bunting. During the depths of winter and early spring it is very numerous in Southern Iowa, where the Snow Bunting is comparatively rare. The Longspur remains until the middle of May, and very probably breeds within the State.

55. *P. nivalis.* Abundant. Arrives in the latter part of November and remains till May.

56. *Emberiza graminea.* Abundant, breeding in great numbers in the pine barrens.

57. *E. socialis.* Common, frequenting similar situations with the preceding.

58. *E. Canadensis.* Not very common. In early winter it is extremely abundant in Southern Iowa, but it removes further south during the severest weather. Not observed during summer.

59. *Niphœa hyemalis.* Common; breeds. The Snowbird usually nests in the pines, or on a brushy hillside. The nest is placed on the ground, and is very artfully concealed. The young are able to fly by the middle of June. The Snowbird goes further south in winter; very few remain, even in Southern Iowa, during the most inclement season.

60. *Ammodromus palustris.* Common.

61. *Linaria minor.* Very abundant. The Lesser Redpoll appears in vast numbers, about the middle of October, and remains during the entire winter, proceeding northward, however, some weeks before the Snow Buntings and Longspurs. In its habits, it very strongly resembles the Yellowbird; its notes, too, are very similar, and on their first arrival, the males may sometimes be heard singing the same pleasing song that the Yellowbird sings in May or June.

62. *L. pinus.* Observed in great numbers in the fall. Migrates south in winter.

63. *Carduelis tristis.* Uncommon.

64. *Fringilla iliaca.* Uncommon. A few seen in spring and fall.

65. *F. melodia.* Abundant. The Song Sparrow breeds in great numbers in the brush prairies and along the river valleys, but avoids the pine and tamarack regions. Like the Robin, Bluebird and Chipping Sparrow, it is a far shyer and wilder bird here than in the settled parts of the country.

66. *F. Pennsylvanica.* Abundant. Breeds in the tamarack swamps and windfalls.

67. *F. leucophrys.* Common near the Leaf River, where it breeds.

68. *Pipilo erythrophthalmus.* Common.

69. *Erythrospiza purpurea.* Abundant in fall; not seen during summer.

70. *Corythus enucleator.* Appears about the middle of November, and remains throughout the winter, feeding on the buds and seeds of the alder, birch, etc., as well as of the weeds that abound on the prairies. As with the Redpoll and Snow Bunting, there is a much larger proportion of old birds than there is in the flocks that visit the vicinity of New York, though the adult males are still far outnumbered by the females and young.

71. *Loxia curvirostra.* Very abundant; breeds. I never saw it out of the pineries.

72. *Coccoborus Ludovicianus.* Rather common.

73. *Pyranga rubra.* Common.

74. *Dolichonyx oryzivorus.* Not common.

75. *Molothrus pecoris.* Rare.

76. *Agelæus xanthocephalus.* Seen rarely, and only in spring.

77. *A. phœniceus.* Not very common.

78. *Icterus Baltimorensis.* Rather common. Its favorite haunts are among the tall Norway pines. Arrives about the middle of May.

79. *Quiscalus versicolor.* Abundant; breeds.

80. *Q. ferrugineus.* Very abundant as far west as the Red River. It disappears about the middle of May, and returns in September.

81. *Sturnella neglecta.* Common on all the prairies. Whether this bird is really distinct from *S. Ludovicianus* seems to be rather doubtful. The notes of the Western Lark are certainly widely different from the Eastern; and this difference appears to be the main distinguishing point between them. In Southern Iowa both varieties are to be found; and a series of careful observations satisfied me, that, while *S. neglecta* rarely utters the ordinary whistle of *S. Ludoviciana*, the latter, in turn, though inhabiting the same fields with the former, never gives utterance to its peculiar warble. Here, the *S. neglecta* alone is to be found, and I have never heard it whistle in the manner of the Eastern bird.

82. *Corvus Americanus.* Common. None remain during winter. In Southern Iowa it is quite common at that time.

83. *Garrulus cristatus.* Common. Resident.

84. *G. Canadensis.* Common; breeds. In summer it haunts the dense gloomy tamarack and spruce swamps, where it breeds. Although it is so abundant, I could not find its nest; but I have reason to believe it builds in the tops of the thickest spruce and fir trees.

85. *Lanius borealis.* Common in spring and fall.

86. *Vireo solitarius.* Not very common; breeds.

87. *V. Novæboracensis.* Not common.

88. *V. olivaceus.* Uncommon.

89. *V. flavifrons?* Rare.

90. *V. gilvus?* Possibly *V. Philadelphicus.* Not common.

91. *Bombycilla Carolinensis.* Abundant.

92. *Sitta Carolinensis.* Abundant; breeds.

93. *S. Canadensis.* Abundant. Less so, in summer, but many remain to breed.

94. *Trochilus colubris.* Rather common.

95. *Alcedo alcyon.* Abundant.

96. *Picus pileatus.* Not common.

97. *P. villosus.* Abundant; resident.

98. *P. pubescens.* Less abundant than the preceding.

99. *P. arcticus?* Not common; breeds.

100. *P. erythrocephalus.* Abundant. I was much surprised to find that the Red-bellied Woodpecker, *P. Carolinus*, does not inhabit this region. During winter it is exceedingly abundant in Southern Iowa, from which section great numbers migrate on the approach of spring. I had supposed that it crossed over the prairies of Iowa and the southern part of Minnesota, and passed the breeding season in the woods of the northern part of the latter State. I found this to be a mistake, however, as I did not see a single individual during the whole year.

101. *P. auratus.* Very abundant. In spring, the Golden-winged Woodpeckers frequent the prairies in great numbers, venturing many miles from the nearest timber.

102. *Coccygus Americanus.* Possibly the following species.

103. *C. erythrophthalmus.* Not common; breeds.

104. *Ectopistes migratoria.* Very abundant.

105. *Ortyx Virginiana.* The Quail is very abundant in the southern portion of the State, and is gradually extending northward as the country is settled. In the new settlements it is rare; beyond the settlements, wholly unknown.

106. *Tetrao umbellus.* Abundant. The Ruffed Grouse in this part of the country has the rufous chestnut of the back and tail more or less replaced by ashy gray. In four out of five birds, there is no trace of red whatever on the tail, while on the back and scapulars it is more restricted, and not as bright as in southern and eastern birds. This is interesting, as showing an approach to the Gray Ruffed Grouse, *T. umbelloides*, of the Rocky Mountain region. The Deer, *Cervus Virginianus*, and the Red Squirrel, *Sciurus Hudsonius*, are also far more gray than southern specimens.

107. *T. Canadensis.* Abundant; breeds.

108. *T. phasianellus.* Very common. In its habits and notes, this species bears a very strong resemblance to the Pinnated Grouse, which it replaces on the prairies of the Upper Mississippi and its tributaries. I never saw the Pinnated Grouse in this part of the State, nor could I learn that the Sharp-tailed Grouse ever visits the southernmost counties, where the former species is very abundant.

109. *Fulica Americana.* Abundant; breeds.

110. *Rallus Virginianus?* Not very common; breeds.

111. *Grus Canadensis.* Very common; breeds in extensive swamps.

112. *G. Americanus.* I saw but few White Cranes, though I was told that they are quite common at certain seasons of the year, and that they occasionally breed here.

113. *Charadrius vociferus.* Common.
114. *Tringa Bartramia.* Abundant.
115. *Totanus macularius.* Common.
116. *T. solitarius.* Uncommon.
117. *T. flavipes.* Common.
118. *T. vociferus.* Common.
119. *Limosa fedoa.* Abundant in spring.
120. *Scolopax Wilsonii.* Rather common, but not observed to breed. It arrives in the latter part of April, and remains until the middle or close of October. I did not see the Woodcock, though the country, in many places, is admirably suited to its peculiar habits.
121. *Numenius longirostris.* Seen once or twice in spring.
122. *Ardea lentiginosa.* Common; breeds.
123. *A. virescens?* Rare.
124. *Anser Canadensis.* Abundant. A few breed around the marshes and lakes.
125. *A. albifrons.* Common in spring and fall.
126. *A. hyperboreus.* Common in spring and fall.
127. *Cygnus buccinator.* Not common.
128. *Anas boschas.* The most numerous species of Duck. The greater number go north to breed, but many remain, nesting in the marshes and bogs.
129. *A. acuta.* Not common.
130. *A. sponsa.* Very abundant.
131. *A. Carolinensis.* Abundant in spring and fall, but not observed during the breeding season.
132. *A. discors.* Common.
133. *Fuligula rufitorques.* Common.
134. *F. albeola.* Abundant.
135. *Pelecanus Americanus.* Common in spring and fall.
136. *Sterna nigra?* Several species of Terns and Gulls breed around the lakes and ponds.
137. *Colymbus glacialis.* Abundant; breeds.
138. *Podiceps Carolinensis.* Very common.

VII. *Note on the Earth Worm.*

By R. T. Knight.

I find that the Earth Worms leave their holes just before dark. When mated they appear double the thickness and about ten inches long. I have seen several of that length, and they are generally considered as one worm.

The mouth is at the anterior extremity, and is an opening large enough to enable the worm to swallow grass clover, and to carry pellets of earth fully as thick as its body. It turns the mouth down so as to resemble that of the sucker fish, and it seems to use the upper part of the mouth as the elephant does the prehensile tip of his trunk.

Recently I saw two large worms united at or near one end, both tails were in the ground; the one on the ground had a concavity extending for several inches on the upper side. The upper worm being connected at the other end, raised the forward part of the body (say nearly two inches long) half an inch above this concave portion and drew it back, then depressing itself till it laid in the groove and pushed itself forward, thus rubbing over the sensitive portion of the worm which was of a yellowish red color, and the groove was covered with a garish fluid. This motion I saw repeated about ten times in succession.

VIII. *Synopsis of the Primary Subdivisions of the Cetaceans.*

By Theodore Gill, M.A., M.D., Ph. D.

The interest that is now being manifested in the Cetaceans has induced me to submit for publication, in advance of similar series for all the mammals, the following series of dichotomous tables of the subdivisions of the order, so far as the suborders, families, and subfamilies are concerned. In the compilation of these tables, I have not only made use of all the material at my disposal, but have availed myself of all the publications on the order as a whole, as well as on its various members. But more especially have I been indebted to the various publications of Professor William Henry Flower, from whose views I have rarely ventured or found cause to dissent.

There are probably few, if any, modern naturalists who have seriously studied the Cetaceans, who do not now consider those animals to be most nearly related to the Carnivores, or Feræ. Between the latter and the Cetaceans of the present age, the gap does indeed appear to be very great, but it is bridged over, to a very considerable extent, by the Zeuglodonts of the Tertiary epoch, and those forms so resemble in some features the Pinnipeds, that the two groups have been combined by more than one naturalist — but notably by Giebel — in the same order. They may indeed be considered as derivatives from the same original stock, and from the Zeuglodont stem have probably descended, in different directions, the Toothed and Whalebone Whales. While the former, in some features, such as the general form of the skull, the teeth, etc., appear to deviate less from ordinary mammals, the latter, in other respects, but especially in the development of the olfactory organ and of the nasal bones, depart less than they from the typical forms. It would therefore seem probable that the *Denticete* have become differentiated as now recognized, little or not at all in advance of the *Mysticete*, or in other words, that the latter are not offshoots from the former, but both from one original stock.

A list of the genera is appended to enable the reader to understand the range of the groups, but no pretense to critical accuracy is made in its behalf, some generic names being admitted for groups which are scarcely of generic value, while other genera, based on extinct species, are omitted, chiefly on account of the doubts relative to their relations.

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§ 1. SYNOPSIS.

SUBORDERS.

I. Intermaxillaries expanded forwards, normally interposed between the maxillaries, and forming the terminal as well as anterior portion of the lateral margin of the upper jaw. Nasal apertures produced more or less forwards. Teeth of the intermaxillaries apparently in normal number (3+3), conic; of the maxillaries, 2- or 3-rooted. **ZEUGLODONTIA.**

II. Intermaxillaries narrowed forwards, forming only the point of the lower jaw, and underlaid by the maxillaries, which form the entire lateral alveolar margins of the jaw. Nasal apertures far back, near the vertex. Teeth (when present) all single rooted.

1. Teeth persistent after birth. Upper jaw without baleen. Rami of lower jaw united by a symphiseal suture. Olfactory organ rudimentary or absent; the nasal bones being appressed on the frontals and overlapped distally. **DENTICETE.**

2. Teeth absorbed and disappearing before birth. Upper jaw provided with plates of baleen. Rami of lower jaw not united by suture. Olfactory organ distinctly developed; the nasal bones projecting forwards, and free at their distal ends. **MYSTICETE.**

ZEUGLODONTIA.

FAMILIES.

I. Anterior nares open forwards; nasal bones elongated. BASILOSAURIDÆ. (I.)

II. Anterior nares open far behind; nasal bones short. CYNORCIDÆ. (II.)

I. BASILOSAURIDÆ Cope.

II. CYNORCIDÆ Cope.

DENTICETE.

FAMILIES.

A. Rostrum of skull with a rounded apex.

I. Upper jaw rostrated and attenuated, or ledge-like around the margin. Skull with the vertex produced forwards. Supraoccipital not projecting

forwards laterally above the temporal fossæ. Frontals visible above only as elongated hook-shaped borders produced backwards around the maxillaries.

a. Costal cartilages not ossified. The tubercular and capitular articulations of the ribs blending together posteriorly. (Flower.) Lachrymal bones coalesced with the Jugals. Orbit very small. PLATANISTIDÆ. (III.)

b. Costal cartilages firmly ossified. Posterior ribs losing their capitular articulation, and only uniting with the transverse processes of the vertebræ by the tubercle. (Flower.) Orbits moderate. DELPHINIDÆ. (IV.)

c. Costal cartilages not ossified. The hinder ribs losing their tubercular, and retaining their capitular articulation with the vertebræ. (Flower.) Lachrymal bones distinct from the Jugals. ZIPHIIDÆ. (V.)

II. Upper jaw not rostrated or marginated; snout high towards the front and projecting beyond the mouth. Skull raised behind and retrorsely convex. Supraoccipital projecting forwards laterally above the temporal fossæ. Frontals visible above as erect triangular or *retrorsely* falciform wedge between the maxillaries and supraoccipital. PHYSETERIDÆ. (VI.)

B. Rostrum of skull prolonged into a slender, straight beak, the premaxillary and maxillary bones forming a cylinder, bearing teeth on its proximal portion. RHABDOSTEIDÆ. (VII.)

III. PLATANISTIDÆ Flower.

SUBFAMILIES.

1. Maxillary bones with crests null or little developed. Many of the teeth with a complete cingulum, or a distinct tubercle at the base of the crown.

a. Postorbital and zygomatic processes disconnected. Jugal with a well developed, curved, ante-orbital process. Maxillary not contracted, without crest, and with convex free margin at suborbital region. INIINÆ.

b. Postorbital process and zygomatic process of squamosal connected. Frontal with a little developed ante-orbital tubercle. Maxillary contracted, with a crest and free margin over suborbital region. PONTOPORIINÆ.

2. Maxillary bones with large bony incurved crests. Teeth without cingulum or tubercles. (Visual organs rudimentary. External respiratory apparatus longitudinal.) PLATANISTINÆ.

IV. DELPHINIDÆ Flower.

SUBFAMILIES.

1. Digits with not more than 4-5 phalanges to each.
   a. Cervical vertebræ all distinct. DELPHINAPTERINÆ.
   b. Cervical vertebræ more or less (2 to 7) consolidated. DELPHININÆ.
2. Digits with numerous phalanges. GLOBIOCEPHALINÆ.

V. ZIPHIIDÆ Gray.

SUBFAMILIES.

I. Maxillaries with no incurved lateral crests. ZIPHIINÆ.

II. Maxillaries with greatly developed incurved crests. ANANARCINÆ.

VI. PHYSETERIDÆ Gray.

SUBFAMILIES.

1. Head very large, truncated in front. Blow-hole near the edge of the snout. Cerebral cavity declining downwards. Jugal and zygomatic process of squamosal connected. PHYSETERINÆ.
2. Head moderate, conic in front. Blow-hole frontal. Cerebral cavity inclining upwards. Jugals and zygomatic processes of squamosals remote. KOGIINÆ.

VII. RHABDOSTEIDÆ Gill.

MYSTICETE.

I. Cervical vertebræ separated in whole or in part. Digits 4. BALÆNOPTERIDÆ. (VII.)

II. Cervical vertebræ coalesced. Digits 5. BALÆNIDÆ. (IX.)

VIII. BALÆNOPTERIDÆ Gray.

SUBFAMILIES.

I. Throat not plicated. Dorsal fin null. AGAPHELINÆ.

II. Throat longitudinally plicated. Dorsal fin developed.
  a. Dorsal fin hump-like. Pectorals very long, with the four digits segmented into many phalanges. MEGAPTERINÆ.
  b. Dorsal fin high, erect, falcate or subfalcate. Pectorals moderate, with the four digits, each having four to six phalanges. BALÆNOPTERINÆ.

IV. BALÆNIDÆ Gray.

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§ 2. LIST OF GENERA.

A. ZEUGLODONTIA.

I. BASILOSAURIDÆ.

Basilosaurus Harl. = *Zeuglodon* Owen.

II. CYNORCIDÆ.

Cynorca Cope.
Squalodon Grat.
Colophonodon Leidy.
Stenodon Van Ben.

B. DENTICETE.

III. PLATANISTIDÆ.

PONTOPORIINÆ.

Pontoporia Gray.
Lophocetus Cope (extinct).

INIINÆ.

Inia D'Orb.

PLATANISTINÆ.

Platanista Cuv.

GENERA INCERTÆ SEDIS.

Tretosphys Cope (extinct).
Priscodelphinus Cope (extinct).
Zarhachis Cope (extinct).

IV. DELPHINIDÆ.

DELPHINAPTERINÆ.

Delphinapterus Lac., Lillj.=*Beluga* Gray.
Monodon Linn.

DELPHININÆ.

Delphinus Linn.
Tursiops Gerv. = *Tursio* Gray.
Lagenorhynchus Gray.
Sotalia Gray.
Steno Gray.
Leucorhamphus Lillj.=*Delphinapterus* Gray (not Lac.).
Pseudorca Reinh.
Orca Gray.
Orcaella Gray.
Phocæna Gray.
Neomeris Gray.
Sagmatias Cope.

GLOBIOCEPHALINÆ.

Globiocephalus Gray.

V. ZIPHIIDÆ.

ZIPHIINÆ.

Ziphius Cuv. (=*Epiodon* Gray).
Berardius Duv.
Mesoplodon Gerv. (=*Ziphius* Gray).
Dioplodon Gerv., et al. (extinct).

ANARNACINÆ.

Anarnacus Lac.=*Hyperoodon* Lac.

VI. PHYSETERIDÆ.

PHYSETERINÆ.

Physeter Linn.=*Catodon* Gray + *Physeter* Gray + ? *Meganeuron* Gray.

KOGIINÆ.

Kogia Gray.
Callignathus Gill.

GENERA INCERTÆ SEDIS.

Orycterocetus Leidy.
Ontocetus Leidy.

VII. RHABDOSTEIDÆ.

Rhabdosteus Cope.

C. MYSTICETE.

VIII. BALÆNOPTERIDÆ.

AGAPHELINÆ.

Agaphelus Cope.
Rhachianectes Cope.

MEGAPTERINÆ.

Megaptera Gray.
Eschrichtius Gray.

BALÆNOPTERINÆ.

Physalus Gray.
Sibbaldius Gray.
Balœnoptera Lac.

IX. BALÆNIDÆ.

Balœna Linn.
Eubalœna Gray.
Hunterius Gray.
Palœocetus Seeley (extinct).

IX. *On the Myology of the Ornithorhynchus.*

By Elliott Coues.

Although the Ornithorhynchus has been repeatedly dissected in Europe, such is not the case in this country; where, moreover, no treatise on its anatomy is generally accessible. We publish, therefore, notes of a recent dissection of the muscles, rather with the design of partly supplying a want that many students must have felt, than with the idea of advancing anything new or specially important; although, we should add, some of the muscular homologies are discussed upon a hypothesis of antero-posterior symmetry not yet generally received. We are indebted to Prof. Agassiz for the use of a specimen from the Museum of Comparative Zoölogy, Cambridge, received through the kind attentions of Prof. Wilder; an adult male, in good condition, except that the head was severely shattered by a charge of small shot.

We find it convenient to group the muscles in the following manner, which probably, also, is not entirely unnatural:—

I. Cutaneous Muscles.
II. Vertebral Muscles.
  a. Of the Head.
  b. Of the Neck.
    a′. Anterior vertebral.
    b′. Posterior vertebral — and not upward prolongation of dorsal muscles.
  c. Of the Back.
  d. Of the Tail.
III. Cervical Muscles: — superficial, not connected with vertebræ or scapula.
IV. Thoracic Muscles. (Intrinsic.)
V. Abdominal Muscles. (")
VI. Perinæal Muscles. (")
VII. Muscles connecting the shoulder-girdle with the body.
VIII. Muscles of the anterior extremity.
  a. Acting upon the humerus.
    a′. — From the body; "long."
    b′. — From the scapular arch; "short."
  b. Acting upon the forearm.
    a′. — From the body; "long."
    b′. — From the scapular arch; — "long."
    c′. — From the humerus; — "short."

c. Acting upon carpo-metacarpus, from humerus or forearm.
d. Acting upon digits.
a′. — From humerus or forearm.
b′. — From carpo-metacarpus.

IX. Muscles connecting the pelvis with the body.

X. Muscles of the posterior extremity.
a. Acting upon the femur.
a′. — From the body; "long."
b′. — From the pelvis; "short."
b. Acting upon the leg.
a′. — From the body; "long."
b′. — From the pelvis; "long."
c′. — From the femur; "short."
c. Acting upon the tarso-metatarsus from femur or leg.
d. Acting upon the digits.
a′. — From femur or leg.
b′. — From tarso-metatarsus.

The intrinsic muscles of special organs belong rather to a treatise upon those organs than to one upon the general muscular system, and are not included in the present memoir.

I. Cutaneous Muscles.

The animal may be said to be tied up in a fleshy sack, with six principal openings for the head, tail, and four limbs. This muscular tunic is remarkable not only for its great extent, but for its thickness in most parts, the various directions of its fibres, and the number and diversity of its accessory slips and their attachments. It is everywhere intimately adherent to the skin; so closely, that in fact it is difficult or impossible to dissect it cleanly from the integument. On the other hand, its connection with the body is correspondingly loose, through the medium of copious areolar tissue especially lax and abundant over the back, chest and sides, dwindling over the episternum and front of the neck, and giving out on the limbs. Practically it will be found best to raise the panniculus with the skin in large, well defined flaps (taking care to note its several definite bony attachments), clear off the cellular tissue, and study it from the inner side. It will be found to descend upon the limbs nearly to the wrists and ankles, where it is drawn tight, like the wristband of a sleeve. The muscle may be further described in detail as follows: —

Panniculus carnosus. — It begins behind by a pointed extremity on either side of the tail near its base, made up by several (about four) fleshy digitations arising from as many transverse processes of coccygeal vertebræ — the first or anterior digitations being opposite the great caudo-tibial muscle. The two sides of the muscle soon come together over the back of the tail, there forming a deep reëntrant angle; after thus joining, the single plane, at once becoming very thick,

runs up the back and sides with uninterrupted longitudinal fibres. On the ventral surface of the tail, there is a similar coalescence of the two sides, at a point just in front of the anus, or just behind where the *intertibialis* crosses from one side to the other; the plane, thinner than that on the back, runs uninterruptedly up over the belly.

Some distance behind the leg, the longitudinal fibres part on the side of the body preparatory to forming the leg-opening. But across the triangular space that would thus be left, semicircular loops are thrown, with less and less belly from behind forward, until they are nearly transverse just at the back of the leg; these sweep around the leg on both sides, embracing it and then coming together again in front of it; the opening thus made is pyriform in shape, with the point forward. A little above the heel, the muscle and skin together are pretty firmly attached, not only to a naked space on the tibia, but by dense areolar or fascial extensions, containing much fat, betwixt the tendons of the muscles.

Where the intertibialis crosses, this is firmly connected with the panniculus, though not to any special detached slip of the latter that we could discover.

Uninterruptedly surrounding the whole body, and with simple longitudinal fibres, the muscle runs up to the neck. The provision for the arm-opening is essentially the same as that for the leg-hole, only the point of the pyriform orifice is directed backward; the muscle descends on the arm; some fibres have definite attachment to the lower third of the ulna; others less definite fascial connection on the other side, with the lower end of the radius, and with the septa betwixt the flexor tendons of the wrist.

A few longitudinal fibres are continued from the breast up to the neck; with the exception of these, and of the hyoid fasciculus, to be presently noticed, the fibres are here transverse, without a median raphé, and sweep over the sides of the neck; they extend quite to the back, and overlie the cheek-pouches. These transverse fibres, and in general, all of the muscle upon the ventral aspect of the body, are thinner than those on the dorsal; and there is a remarkable thickening, as a longitudinal band, along the side of the neck, formed in a manner noticed below.

Its special slips and their attachments. — An *hyo-dermal* muscle is thus formed: Over the episternal bar, a curved fan- or horn-shaped set of fasciculi are developed from the inner surface of the panniculus; these curve inward as they pass forward, narrowing to definite fleshy insertion into the body of the os hyoides, on either side of its median line, in mutual apposition. A *brachio-dermal* is formed over the *latissimus* and side of the thorax generally, by a heavy reënforcement to the inner surface of the muscle, of a broad, fan-shaped plane growing

thicker and narrower as it passes forward to definite insertion (fleshy, or by a very short tendon) into the pectoral crest of the humerus, alongside the insertion of the *pectoralis major*. The anterior border of this *dermo-brachialis* corresponds in a general way with the posterior border of the great pectoral. A third distinct slip, large and important, forms what may be called the *costo-dermal* fasciculus. It arises by two definite fleshy digitations from the 12th–13th ribs, respectively 1′ and 1½′ from the back-bone, and forms a long, slender, flat ribbon, that runs straight up the side of the body along the anterior border of the lower trapezius, underneath the main plane of the panniculus, lying upon the latissimus, to the shoulder; passing just behind the elbow, widening over the shoulder, becoming then blended with the panniculus along the side of the neck, then separating again, and finally inserted into the back part of the cheek-pouch.

In considering the form and uses of this great muscle, probably representing the extreme case of its development in the mammalian series, we are struck first with its nearly equal and essentially symmetrical presence on both the anterior and posterior halves of the body. Acting as a whole we see how, in connection with the thick skin, dense fur, and subjacent flocculent areolar tissue, it contributes to fill up the various irregularities of the surface of the body, and produce a shape offering least resistance in passing through the water; while, moreover, this everywhere contractile tunic must largely assist in producing the various undulatory motions of a body suspended in a fluid of nearly its own specific gravity. Its two lateral caudal prolongations resemble tiller-ropes to guide the side motions of the rudder-like tail; its two lateral costal slips bend the whole body sideways. The hyoid slip is a retroductor of that bone, in action intermediate between sterno- and omo-hyoid. The brachial fasciculus acts like an accessory pectoralis major. The cheek-pouch slip pulls that organ directly backward, and appears to be in antagonism with the special orbicular muscle that surrounds and contracts the pouch; while the transverse fibres that spread over the latter compress it and assist the orbicular muscle in emptying it. (The dissection was here a little obscure, owing to laceration of the parts; but we believe such is the arrangement.) Finally, the fascial attachment of the muscle at the lower arm and leg, where the limbs protrude through the orifices, renders the panniculus an accessory mover of the limbs in various directions.

II. Vertebral Muscles.

a. Of the Head.

Unfortunately, the shattered state of the parts prevented any satisfactory dissection here.

b. Of the Neck.

(a′. — Anterior vertebral.)

Scalenus. — There is but one — a small insignificant slip proceeding to the first rib, to be inserted opposite the origin of the first digitation of the *serratus magnus*. It lies on the extreme side of the neck, just in front of the cervico-scapular muscle, and appears to begin there, with attachment at the middle of the neck; but it is really continuous by a slight tendinous intersection, with a portion that runs higher up, with attachments all along to its real origin, definite, at the apex of the spur of the hypapophysis of the atlas.

Longus colli. — An upper portion is not demonstrably distinct from the lower; its place is apparently taken by the unusually large muscle next succeeding. The muscle lies upon the bodies of the vertebræ, with attachments by slips as usual to 5–6 processes, from first dorsal upward; below, it terminates inside the chest.

Rectus capitis anticus major. — Large; arising both tendinous and slightly fleshy from the basioccipital just in front of the articulation, passing down over the hypapophysis of the atlas without attachment thereto, in apposition with its fellow; forming a distinct fleshy fusiform belly, traversing the whole length of the neck in front, with attachments by slips to the anterior aspect of transverse processes, more or less blended with the similar digitations of the *longus colli*.

R. c. a. minor?, or *lateralis?* (possibly neither, as it has no origin from the atlas). — A rather large muscle, arising fleshy from the whole length of the transverse process of the *axis*, passing upward across the atlas, between its transverse process and its hypapophysial spur, narrowing as it ascends, to the head (insertion destroyed in the specimen). Just back of this muscle, and appearing like a prolongation of it, interrupted by the transverse process of the atlas, a little muscular plane runs from the process just named to the roots of the spinous processes of 3d–4th cervical vertebræ. This is entirely distinct from the series of cervical *intertransversales*.

(b′. — Posterior vertebral — and not upward prolongation of dorsal muscles.)

The two *recti capitis postici*, if these occur, were completely destroyed.

Obliquus inferior. — Of great size, as in some marsupials that, like *Didelphys*, have greatly developed cervical spinous processes; and resembling a second *complexus*, but of course without cranial attachment. A bulging fleshy mass, arising muscular from the sides of the spinous processes of axis and next 3 vertebræ, by 4 digitations; passing obliquely upward and outward to be inserted fleshy into the whole upper surface of the transverse process of the atlas. A powerful rotator of the head, as in the action of shaking it sideways.

O. superior. — A small terete muscle, arising fleshy from the poste-

rior corner of the edge of the transverse process of the atlas, and proceeding straight up to —— (the head? — insertion destroyed).

Splenius. — (Upper half much mutilated); apparently no distinction of *S.* "*capitis*" and "*colli.*" Below, a large, rather thin, fleshy plane, passing a little obliquely from the head downwards toward the middle line of the neck; terminating about opposite the last cervical vertebra, where, and for a little distance below, it is united with its fellow by a tendinous raphé. Superficial, with the usual relations to all deep-seated muscles.

Complexus. — (Destroyed above); below, an oblique plane, of rather small size, just internal to the *trachelo-mastoideus;* inserted by about 4 fleshy digitations into the spinous processes of as many lower cervical vertebræ.

Biventer. — (Mostly destroyed); but, as well as we can determine from the mutilated remains, differentiated from the *complexus;* a terete fascicle along the median line of the back of the neck, with no tendinous intersection.

Trachelo-mastoideus. — (Destroyed above; arises from mastoid. — Owen); below, a mostly distinct and rather terete than digitate muscle, separating *complexus* from "transversalis colli," and somewhat blended with the latter. No tendinous intersections observed; insertion by about 3 closely approximated, and in fact, blended, thick, fleshy digitations, into the bases of the transverse processes of as many lower cervical vertebræ.

c. Of the Back (with their cervical prolongations).

Not to enter upon details alike tedious and fruitless, we may rather briefly notice the conformation of the special muscles of the back.

Disregarding for the time the caudal prolongation of the longissimus, the *erector spinæ* may be said to begin over the pelvis opposite the tip of the ilia; it is at the outset completely differentiated into "*longissimus dorsi,*" or erector proper, and "*sacro-lumbalis*" or "*ilio-costalis;*" the latter, separate in its whole extent, is not further divided into a "musculus access. ad s.-lumb.;" it continues up the neck as "transversalis colli and cervicalis ascendens," which are separated by the *trachelo-mastoid* and *complexus* from the corresponding cervical prolongations of longissimus proper, viz., semi-spinalis dorsi et colli, and multifidi. To this general indication we may add the following descriptions:

Longissimus. — In the loins a remarkably distinct, flattened terete belly, almost wholly muscular, without dense aponeurotic investment, and with only a few (3-4) distinct fasciculi or digitations, that arise from lumbar transverse processes. Already differentiated, as just said, from sacro-lumbalis, the muscle runs upward with a nearly uniform width, and straight, somewhat free, outer border; opposite the last

rib it becomes invested with a glistening aponeurosis, at first sight plain and single, but readily resolvable (more especially a little higher up) into a series of oblique fascial tendons running inward and upward, with pretty definite insertion into apices of successive transverse processes; the arrangement is clearest at the top of the thorax but is essentially the same throughout. Now on raising the outer border of the whole muscle, and dividing successive costal attachments so as to reflect it over towards the spine and expose its under surface, a perfectly regular series of tendino-muscular slips is brought to view. Counting 2-3 lumbar ones, there are about 14 in all, arising distinct and tendinous, from transverse processes, passing obliquely upwards and outwards. These are best displayed along the middle of the back; they terminate opposite the 3d and 4th ribs, at least as far as longissimus dorsi is concerned, being transferred to the outer (costal) branch of the erector (*i. e.*, cervical prolongation of sacro-lumbalis = "transversalis colli"). Above this point the longissimus dwindles into characters of semi-spinalis dorsi et colli; and the few muscular-tendinous fibres pass obliquely downward and outward, instead of upward and outward, like those of the back. External to these, "transversalis colli" lies along the side of the neck, betwixt the digitate insertion of the trachelo-mastoid and the "cervicalis ascendens," blending with both of these. It may be said to arise from the most prominent transverse processes of cervical vertebræ, by tendon scarcely separable from that of the *c. ascendens;* it passes downward and obliquely backward, ending with longissimus opposite the 3d and 4th ribs, with fascial attachments all the way.

Sacro-lumbalis. — This is the outermost of three different planes that may be distinguished in the loin (longissimus making a fourth). It is there a thin fan-shaped plane, taking definite origin from the tip of the ilium, and passing upward spreading over the ribs. This costal expansion is continuous over the whole length of the thorax (with no differentiation into "musc. accessorius"), and entirely separate from any part of the longissimus; it is wholly costal, without vertebral attachment. It is an inch and a half broad at its widest part; its outer border is very convex, and runs a little back of the line of the digitations of the obliquus abdominis; its inner or posterior border is straight, and corresponds with the outer border of the longissimus; the plane is very thin, and intimately attached to each rib as it passes over it; to the eye, in fact, it resembles a set of supernumerary intercostals, with perpendicular instead of oblique fibres; we should judge it to be more of a respiratory muscle than a back-straightener. Towards the top of the thorax it grows narrower, and becomes, on the neck, cervicalis ascendens, differentiated from other nuchal muscles by the intervention of trachelo-mastoideus, and

lying the most laterally of any of them. It finishes by insertion, by an aponeurosis of blended tendons, into the 4-5 lower cervical vertebræ, at the apices of their transverse processes.

A second lumbar plane is thicker and narrower; like the last, it arises from the apex of the ilium, and runs to the last rib; it may be a disintegration from the sacro-lumbalis; but it seems to represent lumbar continuation of a series of 'levatores costarum'?

Quadratus lumborum.—This is rather thin, subtriangular, arising, like the two last, from the iliac extremity and passing to the last and next to the last, rib, with attachment also to vertebræ on its way.

Thus there is no very remarkable deviation from a usual standard, nor any specially interesting conformation of the cervico-dorsal vertebral muscles. Among notable absentees, however, the *serrati postici* may be mentioned. As a whole, the back muscles are not very large; those of the nape exceed them, comparatively; and these again are surpassed in development and complexity of structure by the caudal muscles destined to move the great heavy thick-skinned, fat-laden tail that acts as a rudder when the animal is swimming.

d. Of the Tail.

Levator caudæ.—This is the uninterrupted prolongation of the longissimus to the tip of the tail. As the muscle passes down over the back of the sacrum, it forms a single thick terete fleshy belly on either side, filling the deep groove between the ilium and vertebral spines, soon tapering and filling the similar groove on either side between spinous and articular processes of caudal vertebræ, with attachments all along its course. These last consist, on the upper part of the tail at least, of distinct tendons terminating the muscular fasciculi that are given off; they are implanted into zygapophyses. Towards the tip of the tail, such definite arrangement is scarcely or not demonstrable.

Extensor lateralis.—The median extensor of the tail is small compared with this lateral one that forms the chief bulk of extending muscle. The latter is incompletely divisible above into two portions; the larger one arises from the back of the iliac extremity; the smaller and more lateral portion lower down on the same bone; the two are afterward blended. The superior part mostly fills the fossa between articular and transverse processes, lying upon the latter. Its upper surface is invested with a strong dense fibrous sheath, that may be split into numerous tendons, each of which arises from a partly differentiated muscular fasciculus. Tendons thus extend to the tip of the tail, but most of them pass a little obliquely inward towards the median line for insertion,—an arrangement most obvious along the middle of the tail. The lateral bundle of the muscle gives off from its border and under surface about 6 distinct tendons from muscular fasciculi, that pass to definite insertion into the tips of the transverse

processes of as many caudal vertebræ; beyond, it is indistinguishable from the rest of the muscle.

Flexor lateralis.—The smaller of the two perfectly distinct caudal depressors is wholly ischio-coccygeal, arising definitely from the tuberosity of the ischium by a broad fleshy origin. It is a somewhat square, entirely fleshy plane proceeding obliquely outward and downward to be definitely inserted by about 3 digitations into the transverse processes of as many coccygeal vertebræ, just in advance of the origin of the caudo-tibial muscle.

Depressor caudæ.—The principal flexor of the tail is the largest of all, as well as the most complex in structure; and doubtless, to judge from the obliquity of its segregated fascicles, it subserves other movements of the member. It arises, first, inside the pelvis just behind the acetabulum, and at the junction of the haunch-bone with the sacrum; it may be said, further, to take continuous origin thence to the tip of the tail, from the apices and under surfaces of all the transverse processes. The fibres are very oblique; except at first, in fact, it may be regarded as a series of many such diagonal slips, partly blended together. The under surface is invested with an extremely dense glistening aponeurosis, made up of a number of obliquely set, overlapping or imbricated laminæ of fascia, each of which is the broad flattened tendon of a muscular fasciculus. These aponeuroses combined are the tendon of insertion of the muscle into the vertebral bodies from near the base to the extreme tip of the tail.

Besides the foregoing caudal muscles, there is a series of well developed intertransversales; and another set of smaller slips runs along the articular eminences. The tibio-caudal muscle, although attached to transverse processes, as it passes by them, extends to the median line of the tail underneath, by a thin, broad, flat tendon that lies external to the main flexor of the tail.

III. Cervical Muscles: — Superficial, and not connected with vertebræ or scapula.

Under this head will be noticed the sterno-mastoid and principal muscles of the hyoid apparatus. The first named is double on each side, unless one portion is "cleido-mastoid." The hyoid muscles exhibit a remarkable tendency to run together, both by lateral blending and by end-to-end joining, in several cases where among most animals they are distinct.

Sterno-mastoid.—The *superficial* portion is the larger: it arises by a short flattened tendon from ——— ("the mastoid"—*Owen;* insertion destroyed), and forms a stout, somewhat flattened belly that descends obliquely inward, exactly parallel with, and contiguous to, the anterior border of the trapezius, to be inserted fleshy and by a

very short tendon, into the episternum, a little below and in front of the edge of the bar, on either side of the median line, in apposition with its fellow. It forms, as usual, the letter X with the omo-hyoid. The deep portion is much smaller; it has a separate but contiguous tendon of origin "from the mastoid," and in the neck lies directly beneath, and in apposition with, the other for its whole length. Though thus entirely covered, its course, particularly below, is a trifle oblique to that of the superficial portion, whereby it gains, at length, the outer border of the latter, becomes superficial, and is inserted into the border of the episternal bar, at junction of first and middle third, where the insertion of trapezius ends.

Hyoid Muscles.—The fleshy band that lies upon the wind-pipe is barely or not separable, without forcing the dissection, into right and left halves; there is no distinction whatever of a *sterno-thyroid* from *sterno-hyoid;* nor is a *thyro-hyoid* demonstrable. The common band of muscle arises inside the thorax on the median line, from the lower part of the inner surface of the manubrium sterni (not from the episternum), and runs uninterruptedly up the trachea to the larynx. The median part of the band is attached above to the thyroid cartilage, while the lateral portion passes up without attachment to be inserted into the side of the os hyoides, and especially into the enlargement of the greater cornu; this portion, moreover, appears continuous with *hyo-glossus.* In like manner *mylo-hyoid* and *omo-hyoid* are connected, if not continuous, at the hyoid bone; there is trace of a tendinous intersection, but the hyoid insertion (into the side of the body of the bone) of the two is identical, and some at least of the muscular fibres are not interrupted. The *mylo-hyoid* passes a little outward as it goes to the jaw, and is inserted fleshy upon the outside of the ramus, partly overlapping the latter, and being itself partly overlapped by a muscle to be presently noticed (*a*). There is no evident distinction of *genio-hyoid* from *genio-hyo-glossus;* though these are united (or separated, if the term be preferred) by a tendinous intersection; but the genio-hyo-glossus, on the other hand, is mostly distinct from the hyo-glossus. The *genio-hyoid* runs obliquely forward and spreads outward, partly in apposition with its fellow, to be inserted along the greater part of the ramus of the lower jaw, like the mylo-hyoid, instead of culminating at the symphysis menti. The *genio-hyo-glossus* forms as usual a vertical plane, in apposition with its fellow on the median line; behind, it has the ordinary attachment to the os hyoides, and is considerably blended with the hyo-glossus; its anterior connections are rather with the genio-hyoid than with the jaw itself. The *hyo-glossus* is the longest and most distinct muscle of the three, though continuous behind with the sterno-hyoid, as already stated; it forms a terete bundle on either side of the under surface of the tongue.

(*a*). — A small muscle somewhat resembling another mylo-hyoid, arises with its fellow from the hyoid on the median line, and proceeds forward and outward, spreading over the jaw at its narrowest part, to be inserted into the lower lip.

Another little muscle lies upon the outside of the ramus of the lower jaw, taking definite origin, fleshy, from the fossa at the end of the groove in the bone; it is distributed to the integument of the lip. Transverse fibres of the panniculus, and the muscle *a*, also contribute to the fleshiness of the part.

Other muscles of this region could not be dissected owing to the condition of the specimen.

IV. Thoracic Muscles proper.

These were not dissected.

V. Abdominal Muscles.

The muscular walls of the belly conform to the usual marsupial type in the great size and fleshiness of the obliquus externus, extreme thinness and verticality of the obliquus internus, fleshiness of transversalis, thoracic prolongation of rectus, and extent of pyramidalis. They are chiefly noticeable for the absence of inguinal opening. The quadratus lumborum, often referred here, has been already considered.

Obliquus abdominis externus.—Arises by fleshy digitations from all the vertebral ribs except the two first—the first digitation being continuous with the lower slip from the *serratus magnus;* and separation into digitations becoming obsolete on the last 2–3 ribs; with origin also from lumbar fascia and tip of the ilium. The posterior border of the muscle presents a concavity towards the spine, the most distant point being at the middle of the thorax, about 3 inches from the vertebræ. Except at the extreme lower portion the muscle is fleshy, with the usual direction of its fibres; these continue as far forward as the outer border of the rectus. The insertion is aponeurotic into the whole linea alba, and symphysis pubis; and fleshy into whole length of marsupial bone, its upper edge; at the tip of the latter, there is also an aggregation of fleshy fibres of insertion. There is no arrangement for abdominal rings or 'pillars.'

Obliquus internus. — Extremely thin, and with some difficulty demonstrable from the *transversalis*, even in its muscular portions; but on holding the wall up to the light, the fibres may be distinctly seen decussating with those of the transversalis nearly at right angles. The aponeuroses of the two are blended and completely inseparable after passing beyond the tolerably well defined 'linea semilunaris,' where the muscular fibres of both end. The fleshy part arises mostly, if not wholly, from the iliac extremity, and passes upward with little,

if any, obliquity, terminating at the broad oval cartilages of the floating ribs, as high up, at least, as the 10th from the last.

Transversalis.—Larger and better defined than the last; arising from the whole lower margin of the thorax, internal to the oval cartilages, by slips interdigitating with the diaphragm, from the xiphoid cartilage to the last rib, and thence from the innermost lumbar fascial septum (and so from transverse processes of vertebræ) to the apex of the ilium. The muscle is thickest above, where some fibres reach quite to the linea alba, for 3–4 inches below the xiphoid; further down these cease at the linea semilunaris in the broad thin aponeurosis of median insertion common to this muscle and the foregoing. All the muscular fibres are directly transverse.

Rectus abdominis (*internus*).—Is thoracic as well as abdominal—a long continuous ribbon from episternum to pubes. It arises fleshy at a point at the top of the thorax where epicoracoid, coracoid, episternum, manubrium and first rib meet, taking attachment from all these bones, and also slightly from the next rib as it passes down. On the thorax it rests a little on the sternum, but mostly lies along the ends of the ribs, overlaid by the pectoralis major, and crossed at bottom of the sternum by the obliquus abdominis (some of the fibres of which appear to blend with the outer border of the rectus without reaching the median line). The abdominal portion is a little wider and thinner, in apposition with its fellow along the linea alba, separated from the obliquus externus by interposition of the pyramidalis, and lying wholly exterior to the conjoined aponeurosis of obliquus internus and transversalis—these not forming a sheath below, as in man. The insertion is into symphysis pubis and brim of that bone as far outward as the termination of the articulation of the ossa marsupii. There are no 'lineæ tendineæ transversæ.'

Pyramidalis, s. Rectus externus.—Of great length; and broad at base, in consequence of the outward divergence of the marsupial bones, from the whole length of which (their anterior border), and from the symphysis, the muscle arises. The outer border represents a line from the tip of the marsupial bones to the xiphoid; the inner corresponds to the linea alba. The lowermost fibres are almost directly transverse; the others become successively less oblique to the axis of the body, and finally are nearly longitudinal; the muscle runs to a point above, and is fleshy throughout. It approximates and appresses the marsupial bones, counteracting the obliquus externus, which divaricates them. It is thus in indirect subservience to the reproductive process, in an early state of the young; and similarly, the thoracic prolongation of the rectus internus furthers the bending of the animal in voluntary self-assistance during parturition and subsequent care of the young, as in ordinary marsupials.

VI. Perinæal Muscles.

Not dissected.

VII. Muscles connecting the shoulder-girdle with the body.

Of the several muscles connecting the scapular arch with the body, the deep portion of the sterno-mastoid, which is really essentially clavicular in its insertion, has been already considered. The omo-hyoid, as usual, forms the direct muscular band between the hæmal arches of consecutive cranial vertebræ, in this repeating an ordinary intercostal. The others are in three sets, arising from *a*, spinous processes of vertebræ along the median line, *b*, processes of cervical vertebræ along the side of the neck, and *c*, from the thorax. Trapezius is in two parts, one of which is thoracic, while rhomboideus is single; the cervico-scapular plane, answering to 'levator anguli scapulæ,' is double; besides which, there are, as in ordinary marsupials, two perfectly distinct atlanto-scapular levators. The costo-scapular plane (serratus) is small and slight, and differs from that of some (all?) marsupials in being entirely distinct from levator anguli proper; there are also other thoracic muscles passing to the shoulder apparatus. As a whole, the scapular arch is much less mobile than usual, in consequence mainly of the episternal attachment and coraco-sternal articulation.

Omo-hyoid.—As already stated, continuous with the mylo-hyoid, at its hyoid point of insertion; and there is no division into two bellies by a tendinous intersection, nor any confining of the muscle in its continuity by an aponeurotic pulley. Above it is partly divisible into two fasciculi, the smaller internal one of which is inserted lower down on the hyoid than the other, and is distinct from mylo-hyoid. The muscle forms a single flat ribbon, at first descending nearly straight down the neck, then passing obliquely outward, crossing behind the s.-mastoid, between this and levator anguli scapulæ, and dipping beneath the episternal bar, to be finally inserted on the scapula, partly fleshy and partly tendinous, just below the acromion, in a notch half way between clavicular and humeral articulations. The ordinary action.

Trapezius.—Large; distinct from deltoid, as in claviculate animals generally, and further resolved into two entirely distinct portions, as if by disappearance from the back between and in advance of the shoulders, of the part corresponding to the aponeurotic space of the human subject. The *anterior part* arises from the occiput (precise limits of origin not visible in the specimen), and thence down the median line of the neck, by an aponeurosis common to it and its fellow, with only secondary connection with cervical spines, to a point opposite the most prominent part of the scapula, to which the lower border

of the muscle runs transversely; the anterior border folds around the side of the neck parallel and in apposition with the s.-mastoid; the insertion is partly fleshy, partly tendinous, into the scapular spine, and border of episternal bar, as far to the front as the insertion of the deep s.-mastoid. The posterior part arises from the 10th–11th ribs by two fleshy digitations situate respectively 1′ and 1½′ from the back-bone, and from a broad, oval, dorsal aponeurosis common to it and its fellow. The muscle has the form of a narrow scalene triangle; its lower border approaches the spine about the middle of the back, and is there contiguous with its fellow; the anterior border passes straight up the side of the chest, lying upon the latissimus, past the back of the arm; the acute apex is inserted by a very short, thick tendon into the end of the scapular spine, in connection with the posterior corner of the insertion of the anterior trapezius, and of the deltoid behind — the latter curving down in front of the arm, which is thus set in a deep recess betwixt these two muscles. Under this portion of the trapezius, in the deep hollow of the back between the shoulders, the large gland lies embedded in copious lax areolar tissue. When the two parts of the trapezius act together the effect is much the same as if they were not disjoined; the special effect of their dissentaneous action, if they have such, is not so evident.

Rhomboideus. — Single; of large size, and thick. It arises in apposition with its fellow along the median line of the neck behind (disposition above, and cranial attachment, if any, not seen); the lower border passes transversely to the scapula, and a little downward; the insertion, broad and fleshy, is into the apex behind, and about ⅓′ along the posterior border of, the scapula. Has the usual action.

Costo-scapularis; serratus magnus s. anticus.—Perfectly distinct from the cervico-scapular plane, from which it is separated by a triangular interval an inch wide in front, narrowing behind as the two muscles mutually approach towards the apex of the scapula. The muscle is unusually small, consisting of only three short digitations from 1st–3d ribs, rapidly lengthening from first to third, the last almost perfectly continuous with the first slip from the obliquus abdominis; the three fascicles remain distinct near to their insertion, which is by a short terete tendon into the very tip of the scapula. Has the usual action.

Pectoralis minor? — Besides the serratus, another plane of muscle connects the shoulder apparatus with the top of the thorax; it has somewhat the situation and relations of an 'intercostal' betwixt first rib and the bones above. It is divisible into two parts. One of these, costo-coracoid, is larger and thicker than the other; it arises from the first rib, from the origin of the serratus magnus slip to the sternal articulation, and is inserted mainly into the base and inner surface of the coracoid. A smaller, thinner plane, manubrio-epicoracoid,

expands upon the internal surface of the epicoracoid plate. The first of these may be pectoralis minor; the second, subclavius?

The cervico-scapular attachments are several, and rather complicated. We have, first, two distinct muscles, both arising from the spur of the atlas hypapophysis, but with separate scapular attachments; each of these is a single belly. Then there are two planes of digitate muscles, each arising from several cervical processes, and with different scapular insertions. These last probably represent duplicate levatores anguli scapulæ proprii; while the two first named (also occurring in marsupials and other animals) are "protractores scapulæ."

"*Atlanto-acromialis.*"—A single thick stout muscle, lying superficial and somewhat to the front, as well as on the side, of the neck, nearly parallel with the omo-hyoid, crossed above by the sterno-mastoid, and overlaid by the trapezius. With the tendinous origin above mentioned (hypapophysial process of atlas) it soon swells to a large belly, and is inserted fleshy into the antero-interior aspect of the scapular crest, and thence in a line behind the episternal articulation as far as the insertion of the omo-hyoid. It draws the shoulder-blade towards the head, and a little to the front.

"*Atlanto-scapularis.*"—Origin with the preceding, and in like manner; and overlaid by it in the upper part of its course. It passes a little more obliquely as it descends, lying upon the deeper muscles of the back of the neck. It has somewhat the appearance of an enlarged and distinct fasciculus of levator proper, with which it is inserted, fleshy, into the antero-internal surface and upper border of the scapula near its apex. Action nearly the same as that of the foregoing, but more oblique.

Levatores anguli scapulæ.—A double plane, with common digitate origins, but separate insertions. Each numbers about 6 slips of origin from the transverse processes of the first dorsal and all the cervical vertebræ except the atlas and axis; the slips are separable nearly to their insertion. The posterior, or internal plane lies directly upon the muscles of the back of the neck; it is quite flat, fan-shaped, and converges from its broad origin to be inserted fleshy, into the posterior extremity of the scapula, from the apex one-half inch up the blade. The digitations are all terete, and lie in the same plane. The other muscle lies anterior to the last; its digitations are broader and flatter, enlarge as they pass to the scapula, and are packed obliquely against each other. The lowermost slip does not reach the scapula, ending in tendinous insertion into the next above; the other five have fleshy insertion into the antero-internal surface of the bone, chiefly on a line near the edge of the crista. The action of both planes is much the same; they draw the bone around to the front and upwards, rotating it a little.

VIII. Muscles of the anterior extremity.

The arrangement indicated in the beginning seems to us fully as convenient as, and much more natural than, grouping the muscles of the limbs upon, and naming the several sets after, the parts upon which they lie, instead of those on which they act.

The humerus, like that of the mole, an animal which uses its fore-limbs in corresponding manner, is short, thick and extremely irregular in superficies, with strong elevations and depressions for advantageous arrangement of the muscles. The bone may be regarded as a knotty osseous nodule interposed between shoulder and elbow-joint for the strong movement of the forearm in several directions; itself moving through little space, but capable of being very powerfully pulled in every direction, and thus laying the foundation, as it were, for the various strong movements of the forearm. It is acted upon, from the body, by the dermo-brachial slip already described, and by the two following muscles:—

a. Acting upon the humerus.

(a'.—From the body.)

Latissimus dorsi.—Notable for its extensive costal, and correspondingly slight spinal, origin. It arises by aponeurosis from about 6 dorsal vertebræ (4th-9th), beginning above at a point just opposite the shoulder, to which, therefore, the upper border passes directly transverse; most of this spinal portion is thicker than the costal. The latter origin is by a series of fleshy slips from the 7th to the 14th ribs, in a slightly irregular curved line the convexity of which is forward; the digitations are separable for some distance, especially the few lower ones. No aponeurosis connects this costal with the spinal portion; such fascia having apparently been appropriated by the lower trapezius and costal slip of panniculus, already described. The lower, outer border of the muscle ascends very obliquely; before insertion, there is a complete twist, as usual, the upper fibres becoming lower by twisting *outwards;* and conversely. Insertion by a short, wide, thin, flat tendon in an oblique line upon the humerus, half-way up the pectoral crest, and thence along the entocondylar ridge to the elbow. The muscle has its ordinary action, very advantageously effected by its extensive and low insertion.

Pectoralis major.—Of remarkable extent. Its origin is in a line from the acromion and whole episternal bar, and thence down the manubrium and sternum and linea alba to within a couple of inches of the pubes. Along the front of the chest it has thick fleshy origin from the ends of the ribs as well as from the breast bone. The abdominal portion is extremely thin—thinner than the same part of the panniculus; the muscle thickens rather abruptly as it passes over the lower

edge of the thorax, and there, near the median line, a slight cellular interval may occur between thoracic and abdominal portions. The chest portion is of nearly uniform, and great thickness; there is no evident distinction of a deep-seated from a superficial part; but the outer half of the episternal portion and the acromial portion are together * separable from the sternal portion, by a slight cellular interval along a line representing the posterior border of the muscle below described as the anterior part of the deltoid. (This last named muscle is crossed at right angles, overlaid, and mostly hidden by the pectoralis.) The rather thin outer border of the pectoralis is nearly in a straight line from the symphysis pubis to the shoulder; the thoracic part of this border lies nearly parallel with the anterior border of the obliquus abdominis. The thick convex anterior border dips down over the posterior border of the deltoid to the humerus. All the fibres of this great muscle converge *without* twisting to an extensive linear insertion by a short stout tendon into the pectoral ridge of the humerus. The acromio-episternal bundle of fibres is set in much lower down than the others, from which they are virtually separated by the insertion of the slip from the panniculus. The pectoralis has the usual action, carried to a high degree; it is also, owing to the great development of the pectoral crest, an unusually powerful rotator of the humerus, an action in which the latissimus assists. The purpose here subserved is evident on reflection upon the way the paddle-like hands should strike the water when the whole arm *is forcibly extended* in giving the backward stroke.

(b.′ — From the scapular arch.)

Deltoid. — (According to high authority, the deltoid is double, and the two muscles about to be described may constitute its two halves; but the anterior of these, which is overlaid and covered by the pectoralis, would hardly recall a deltoid by any physical feature.) The posterior part is of pyramidal shape, with thick fleshy origin from the most anterior (highest) part of the scapula, and a low insertion on the humeral crest by a rather long tendon. Some of its fibres of origin appear almost continuous with those of the posterior trapezius; while it is almost blended with the pectoralis at its insertion. The anterior portion lies upon the epicoracoid plate, conforming

* These portions together are in the ordinary position, and have much the appearance, of a deltoid — in fact, they resemble one much more than the muscle, below described as "anterior deltoid," does. We are in doubt of the accuracy of our identification of the muscle we describe as anterior portion of the deltoid, but can come to no more satisfactory conclusion, without identification of what is described in a preceding paragraph as "Subclavius? Pectoralis minor?" — a determination that we cannot at present make. One of the inner pectorals of birds may furnish the clue.

in contour with the latter; fleshy fibres take origin from the whole surface of that bone. The muscle narrows and curves a little as it passes down, directly overlying the shoulder-joint, and in relation anteriorly with the long epicoracoid head of the biceps, to be inserted fleshy into the most prominent part of the pectoral crest of the humerus, above the insertion of the posterior deltoid. When these two muscles act together, they would have the usual effect in elevating, or abducting, the humerus; acting separately, they have little of this effect, but are respectively extensors and flexors of the bone, with a slight rotating power in opposite directions.

Independently of the foregoing, there are the usual number of scapulo-humeral muscles; but owing to the singular shape of the shoulder-blade, position of its faces, and other causes, it becomes somewhat of a question what names are to be applied to them. We describe them accurately, and if mistaken in identification there will be no trouble in rectifying the error. We determine subscapularis, both spinati, no teres minor, and double teres major, making five in all, as usual.

Supraspinatus. — A slender, straight fascicle, much the smallest of the three that more especially occupy the shoulder-blade. It arises fleshy in the depression between the most prominent point of the scapula and the glenoid — that is, about half-way betwixt these two points, and partly around on the antero-*internal* aspect of the bone (owing to the reflexion of the latter), close by the insertion of the omo-hyoid; it passes straight to the joint, which it directly overlies, and is inserted by a short, flat tendon into the anterior tubercle at the head of the bone, just opposite the proximal beginning of the insertion of the epicoracoid part of the coraco-brachialis. It rotates the humerus outward, as usual directly opposing the subscapularis.

Infraspinatus (and teres minor? or the latter wanting?). — Largest of the three. Occupies, and arises fleshy from, the whole of the scapular plate below the spinous elevation, that is, between the last named and the origin of the scapular head of the triceps; narrowly fan-shaped and slightly curving, to be inserted, partly fleshy and partly tendinous (tendon superior and muscular part infero-external), into the posterior aspect of upper part of pectoral crest, just below insertion of the preceding, which it powerfully aids in rotating the humerus outward.

Subscapularis. — This is in what would be for most animals the usual position of "infraspinatus," and might be taken for the latter, were it not for its widely distant insertion into the other side of the head of the humerus. A rather small subterete fascicle, arising fleshy from that part of the scapula which lies between the glenoid and head of the triceps extensor brachii; crossing to the shoulder-

joint behind to be inserted, chiefly fleshy, into the posterior tubercle upon the head of the humerus. It rotates the bone inwards, feebly counteracting the two preceding muscles.

Teres major. — Double; both portions of great size, and perfectly distinct. The *lower*, or teres major proper, arises fleshy from the posterior extremity of the scapula for about one-third of an inch; it lies at first upon the serratus magnus, and then along the superior border of the latissimus, forming a great pyramidal muscle running between the last and the upper teres, rapidly narrowing to a rather long, stout, flattish tendon that passes behind (mesiad of) the scapular head of the triceps, to be inserted in the posterior ridge of the humerus, one-half inch or more above the insertion of the latissimus. On its deep surface muscular fibres reach nearly to its insertion; on the superficial aspect, the large glistening tendon radiates nearly half way to origin. The *upper* portion is still larger, and has more extensive and complicated origin from both "sides" of the scapula, which is thus, as it were, embraced by the muscle. The outer origin is from the postero-external aspect of the scapula, from the origin of the lower teres to that of the scapular head of the triceps; the inner origin is thinner and more extensive and fleshy, from the whole surface of bone between the insertions of the two digitate sets of levatores scapulæ. The muscle is pyramidal in shape, like, and with the general aspect of, the preceding, and with precisely similar tendinous arrangement. But it is inserted much higher up, in immediate relation with the shoulder-joint, into the posterior tubercle of the humerus, alongside the insertion of the muscle above called subscapularis. N. B. Its tendon contains an articular sesamoid bone.

Two perfectly distinct muscles besides the one above called "anterior deltoid" proceed from the coracoid apparatus to the humerus; they have together been considered as coraco-brachialis, but the name is properly applicable to only one of them.

Coraco-brachialis proper. — This is the posterior, and the longer and slenderer of the two. It arises by a very short tendon in common with the larger moiety of the *biceps*, from the sternal extremity of the coracoid; quickly enlarges to form a flattened-fusiform muscular belly, representing the postero-internal margin of the arm; it is overlaid by the greater moiety of the biceps, itself overlying at first, the muscle next below described, and afterwards the tendon of the *latissimus*, which it crosses at right angles. Its insertion is fleshy and with a very short tendon, into the lower part of the entocondylar ridge of the humerus, nearly opposite the foramen: its outer surface of insertion is in relation with the pronator radii teres.

Epicoraco-brachialis. — Much larger than the other, and with different origin, course, relations and insertion; lying partly upon and

partly under, the whole coracoid apparatus, and upon the posterior aspect of the proximal moiety of the humerus. Viewed at first from the outside, superficially, it appears to arise from coracoid proper, and to descend thence upon the humerus. But its real origin is much more extensive, from the whole, or nearly all, of the under (internal) surface of the epicoracoid lamella, as a thin expanded plane, whose contour is determined by that of the bony plate just named. It gains the outside by curving around the coracoid proper, reminding one of the escape of the iliacus over the pelvic brim, or of obturator internus over the border of the ischium. It has a broad fleshy insertion into the expanded surface of the humerus, upon the aspect of that bone above noted, as far down as the insertion of the latissimus. These coraco-humeral muscles adduct and retroduct the arm, bringing it upon the breast, as in the act of clasping; and have furthermore somewhat the action of internal rotators of the bone.

This extensive and somewhat complicated disposition of the coracobrachial muscles, and their perfect differentiation into two, are in striking contrast with the singularly small and simple condition of the (single) muscle in some animals of the next order above, as the opossum for instance. It is the nearest approach of which we are aware, to the ordinary condition of the antitypic muscles of the hind limb, which are always differentiated into several adductores femoris.

b. Acting upon forearm.

Only one forearm muscle comes from the body: it is the slip from the latissimus. Of the other "long" brachial muscles, the biceps is doubled above, and has a singular disposition; the scapular head of the triceps ("long" extensor cubiti) is entirely discrete from both the other ("short" extensors) heads, for a reason we disclose below. The brachialis anticus ("short" flexor cubiti) is not remarkable. Perhaps the most interesting point regarding the muscles of this part is the remarkable development of the anconæus, and the presence of another antagonistic anconæus, both in subserviency to the peculiar motion that the elbow-joint permits in lieu of pronation. The pronator teres — that very constant muscle in higher vertebrates — is present under ordinary conditions, although there is no pronation possible in the forearm; so also are the two supinators (but the pronator quadratus is wanting?).

Before proceeding to consider the muscles that act upon the forearm, we may notice the method of adapting the whole limb for use as a paddle. The humerus, as we have already seen, is extremely short and thick, and is especially broad across the condyles, where the width is but little less than its whole length. We have also seen that the principal muscles that extend, *i. e.*, retroduct, the humerus,

in the act of giving the stroke to propel the body through the water, are so inserted as to have a strongly rotating effect upon the bone, twisting the limb in such a manner as to throw the elbow up and away from the body. Now the two bones of the forearm are in mutual apposition for their whole length, and so closely bound, that relative motion upon each other is abrogated; the forearm is confined permanently in a state of semi-pronation. But it is evident that the broad surface of the webbed hand must strike the water in the backward stroke, and that the thin edge of the palm must cleave the water in the bringing forward of the member; that is, there must be perfect virtual pronation and supination during each stroke and return to position for the next one. With the forearm bones stiffly bound together to ensure strength and fixity of the wrist and hand, this requisite rotation of the forearm and change through 180° of the plane of the webs is effected by the construction of the elbow-joint, and disposition of the muscles that act from the humerus and scapular arch upon the proximal end of the forearm. The elbow, instead of being the most strict ginglymus in the body, as usual among mammals, is largely amphiarthrodial, permitting free rotation or lateral rocking of the forearm upon the humerus. This compound motion seems to be very nearly like what would occur as a resultant if, in man for instance, the rotation of the head of the radius in its ulnar socket should enter as a component of, and be merged into, the to-and-fro swinging of the forearm upon the humerus. In a word, the animal *feathers its oars at the elbow-joint* — not at the wrist.

In studying the action of the several muscles concerned, we see clearly how this is effected and find the reason for certain peculiarities in their disposition. We have only to add further, in this connection, that the articular facet of the humerus is not directly at the end of the main axis of the bone, but displaced to one side, so as to be at the base of the immensely developed ectocondylar process; that both the widely divaricating condylar processes offer salient *points-d'appui* for the muscular tractions that rotate the forearm; and that the olecranon is a very broad plate curving far up behind the humerus, with widely expanded corners, in subserviency to the varied action of different parts of the triceps and anconæal muscles.

(a′. — From the body.)

Dorso-epitrochlearis. — The forearm slip from the latissimus is well developed. It is given off obliquely from the lower border of the muscle, a little more than an inch from its humeral insertion, and mounts upon the back of the forearm, crossing the limb over the most prominent ridge of the latter. It appears to end in fascia over the middle of the back of the forearm; but may be traced, without unduly forcing the dissection, to pretty definite insertion into the

ulna itself, at about the middle of the bone. The slip is of a nearly uniform width of about a third of an inch, and is thin and flat; it has the usual action.

(b′. — From scapular arch; "long.")

Biceps. — The coraco-radial flexor is in two parts, with rather unusual disposition; one of the "heads" is much larger than the other, and the two arise far apart; but they are implanted together upon the radius. The anterior part — *epicoraco-radialis*—arises fleshy high up on the epicoracoid plate from its border and postero-interior moiety, where it is overlaid by the episternum, and soon forms a slender terete fascicle, which passes outward in relation with the origin of the rectus abdominis, subsequently overlies the anterior portion of the coraco-brachialis, and then comes in relation of contiguity with the other moiety of the biceps, which it separates from the pectoral crista humeri. Passing this last, it changes to a long terete tendon that represents the anterior border of the biceps where this dips betwixt the forearm muscles. The posterior and larger part — *coraco-radialis*—arises from the sternal extremity of the coracoid in common with one head of the coraco-brachialis, and immediately swells into a great, broad, flattish, fleshy belly that passes down the arm lying a little obliquely upon both the coraco-brachiales, and subsequently upon the tendon of the latissimus dorsi. It becomes penniform by insertion into the tendon of the other head of the biceps; posteriorly, the muscular fibres nearly reach the radius. The common insertion of the two is by a broad flat tendon into the middle third of the radius.

(The other (ulnar) flexor cubiti is noticed under the next head, c′).

Triceps, its long head. *Rectus humeri !*—The "long" or scapulo-ulnar extensor of the forearm is remarkably distinct from the two humeral, or "short" heads. It arises fleshy from the posterior concave border of the scapula, from the glenoid an inch or so backward. It is thus a rather thin broad plane, that passes between and separates the two teretes majores (see above) from the other scapulo-humeral muscles; as it descends the back of the arm, it narrows in one transverse direction, and thickens in the other, so that here its greatest diameter is at right angles with the same diameter above. The anterior (glenoid) edge of the muscle is at first in apposition with the posterior surface of the brachialis internus; after the above mentioned change in the long diameter of the muscle, its broad flat surface is similarly applied to the equally expanded surface of the brachialis internus. In place of the tendinous inscriptions that commonly unite this scapular head below with both the humeral heads, we have them separated by cellular intervals. Neither is there an aponeurotic investment of the muscle below; but it has a wholly fleshy, thin,

broad from side to side, insertion with the remarkably wide posterior border of the olecranon.

(*c'*. — From the humerus; "short.")

Triceps, its internal head. *Vastus internus humeri*! — This muscle is of large size, and wholly distinct from the foregoing; it is not divisible into fasciculi. It is fleshy throughout, and of a somewhat pyramidal shape, being broadest below. It lies almost directly posterior upon the humerus, and fills up what would otherwise be a great fossa between the head of the humerus and the olecranon. Its relations are — behind, to the scapular head of the triceps, which is applied flat to its whole surface; in front, mostly to the humerus itself, but also in greater or less part to the brachialis anticus, origins of both inner and outer bundles of forearm muscles, and to the muscle below described as antanconæus; to the outer side, to external head of triceps; to the inner side, to lower part of brachialis anticus, and tendon of latissimus. It takes fleshy origin from the whole of the upper half of the back of the humerus, and is inserted fleshy into the whole width of the edge of the olecranon. At the innermost point, some fibres are collected into a slightly separable bundle, which has more especial and partly isolated insertion into the inner corner of the olecranon.

Triceps, its external head. *Vastus externus humeri!* — Like both the foregoing, entirely distinct, and remarkable for its comparatively small size, its isolation from the humerus in its continuity, its definite tendinous origin and insertion, and peculiar, independent action. The muscle is fusiform in general shape, but somewhat prismatic in a transverse section; it lies entirely away from the humerus, upon the outer aspect of the arm, in a bed formed between the brachialis anticus and inner head of triceps. It arises by two tendons; one is a narrow, flat, strong band from a recess behind the "greater tuberosity" of the humerus; the other a broader, shorter, more diffuse and aponeurotic-like fascia from what would be "neck" of an ordinary humerus. It is inserted by a short, definite tendon into the extreme outer corner of the transversely expanded olecranon.

This last division of the triceps, while extending the forearm like the other two, more especially pulls upon the outer corner of the olecranon, and tips it up sideways, thus producing (in connection with the anconæus) the remarkable rotation of the forearm that answers instead of pronation. The inner head has the reverse action less plainly marked, while the scapular head is the direct extensor; but both these two last have so broad a fleshy insertion into the olecranon, that if they contract unequally in their different parts, they may have corresponding effect in tipping the olecranon sideways. The several actions of the triceps, as a whole, are furthered by the follow-

ing muscles — one of which is an immensely developed anconæus, and the other its peculiar antagonist: —

Anconœus. — Of remarkable size and partly divisible into two portions. One of these occupies the lowest part of the humerus behind, somewhat in the position of what is called subanconæus in anthropotomy; it lies beneath the internal head of the triceps, filling the fossa between the olecranon and the humerus below, arising from all the broad depression between the two condylar ridges. It is triangular in outline, but really tetrahedral in shape, and entirely fleshy. Its fibres pass downward, backward, and very obliquely outward, directly over the back of the elbow-joint, to be inserted into the whole of the superior surface of the olecranon; but some are continuous with the other part of the muscle, or anconæus proper, passing for this purpose through the deep notch between the ectocondyle and the outer angle of the olecranon. The superficial portion of the muscle, however, has pretty distinct origin from the ectocondyle, and thence spreads out fan-shaped, to be inserted fleshy into the whole outer and back surface of the ulna as far along as the origin of the abductor pollicis longus (except just along the edge and at the tip of the bone, which are reserved for origin of extensor carpi ulnaris). The attachments and oblique traction of this muscle make it a powerful rotator of the forearm upon the humerus, as well as an extensor. It is opposed by

Antanconœus. — A muscle of considerable size that lies very obliquely across the *inner* side of the back of the elbow. It arises from the tip of the entocondyle in connection with the pronator and carpal "flexors," and immediately forms a thick, bulging fleshy belly that rather suddenly contracts to a short, stout, rounded tendon to be definitely inserted into the prominent tubercle at the inner corner of the olecranon. The muscle lies mostly upon the expanded inner condyle and fills up what would otherwise be an hiatus between the inner head of the triceps below and the ulnar head of the "flexor" carpi ulnaris. It subserves the rotary motion of the forearm, as well as extends the latter; producing a movement corresponding to supination, and thus directly counteracting the foregoing.

Brachialis anticus. — (Flexor cubiti ulnaris.) Returning now to the flexor set, we find that the "short" or humero-ulnar flexor of the forearm is large and lies rather outside, than in front, of the humerus, in consequence of the singular shape of that bone; it only gains the front more than half way down, and runs up the outside of the bone nearly to the shoulder-joint. Arises, fleshy, from all the depressed space between the great pectoral crest and the prominent ectocondylar ridge; it is overlaid, above, by the external head of the triceps. Becoming anterior, at length, between the condyles, it dips down between the widely separated bundles of forearm-muscles, and narrows

by lateral flattening to be inserted tendinous into the ulna, along the radial edge of that bone from scarcely beyond the elbow-joint half way to the wrist (there being no coronoid process for its definite insertion).

Thus the two flexors of the forearm, ulnar and radial — inner and outer — preserve ordinary relations in the forearm; the biceps not splitting below to have part of its insertion into the ulna, as in certain marsupials. There are only two other muscles that act upon the forearm, viz.: the round pronator and short supinator; for the square pronator is absent, and the long supinator, as usual among mammals, is a humero-*carpal* muscle. The arrestation of this muscle on its way to the carpus and its insertion into the styloid process of the radius, is a teleological modification only found among the very highest mammals.

Pronator radii teres. — Although the forearm is fixed in semi-pronation, this constant muscle is well developed. It is not, however, superficial, and so determining the contour of the part, nor does it arise first or highest up on the entocondyle, but it is deep-seated, and overlaid in greatest part by the "*flexor*" *carpi radialis*. It is a single terete subfusiform belly, with origin from the entocondyle next below the last named muscle, passing obliquely to be inserted into the middle third of the radius by a rather long, flat tendon, in relation, on its radial aspect, with the tendons of biceps and brachialis anticus. Its function is limited to steadying of the parts.

Supinator brevis. — A deep-seated, triangular plane of moderate size; its outer, free border stretches in a straight line between the tip of the ectocondyle and the middle of the radius, and the body of the muscle fills the depression between these points. It has no ulnar origin; but arises from the anterior border and tip of the ectocondyle, and has definite, fleshy insertion into the upper half of the radius — ending just in advance of a point opposite the insertion of the pronator teres. It counteracts this last, but its action must be very limited.

c. Acting upon carpo-metacarpus, from humerus or forearm.

The contour of the forearm is that of a flattened flask, broad above, and rather suddenly contracting to a narrow neck towards the wrist. Above, the fleshy bundles are widely separated, by the whole distance between the tips of the expanded condyles of the humerus; they are thick and bulging, which may be said also of the muscles upon its back. As usual, the aggregate bulk of the muscles upon the front is greater than that of those upon the back; but the latter are more numerous. The disposition of the muscles is simple, compared with that of most higher unguiculates, and there are several notable absentees, as will be stated further on.

Before noticing the individual muscles that act upon the wrist, we should explain the necessity of changing the names of the so-called flexors and extensors. The morphological position of the forearm is with the bones uncrossed in strong supination. Then the palm looks *forward* and downward, with the nails uppermost and pointing *backward;* and in this position the hand is "symmetrical" with the foot, the sole of which looks *backward* and downward, with the nails pointing forward and upward. "Flexion" of a segment is its bending in the contrary direction to that of the segment above; as all admit in the case of the foot, where "flexion" is decreasing the angle formed between the front of the leg and the instep; but the fact has been strangely overlooked by most anatomists in the case of the hand, where apparently its customary pronation has deceived them. "Flexion" of the hand is the bending of that segment in the direction opposite to flexion of the forearm: that is, *backward*, remembering the supine position of the member. The muscles that do this lie upon the back of the forearm and hand, and correspond to those upon the front of the leg and instep; they are those called in anthropotomy the "extensors," but their function is *flexion*. We restore their proper name, and similarly call the "flexors" of anthropotomists, lying upon the front of the forearm, by their proper name of *extensors*.* There is to be no change in the digital flexors and extensors.

The *extensors* (*i. e.*, "flexors" of anthropotomy) of the wrist are only two, ulnar and radial; both of large size.

Extensor carpi radialis. — The first muscle on the ulnar side of the pronator, interposed between this and the flexor digitorum communis; large, and of singularly flattened shape from side to side; very broad above, rather abruptly contracting to a very short and stout tendon. It arises both fleshy and tendinous from the tip of the entocondyle, and thence in a line across the bottom of the humerus in front (dipping into the deep fossa there found) to the radial articulation; and slightly from the head of the radius itself. The tendon, barely one-third of an inch long, mounts a little way up the radial border of the muscle: it is inserted by expanding upon and grasping, as it were, the most prominent carpal bone upon the radial border of the wrist. The usual action.

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*Consult further in this connection—

BURT G. WILDER, *On Morphology and Teleology, especially in the limbs of Mammalia.* Mem. Bost. Soc. Nat. Hist., Vol. I. 1865.

JEFFRIES WYMAN, *On Symmetry and Homology in Limbs.* Proc. Bost. Soc. Nat. Hist., p. 277. 1867.

ELLIOTT COUES, *Antero-posterior Symmetry, with special reference to the Muscles of the Limbs.* New York Medical Record. July, 1870, et seqq.; pp. 149-152, 193-195, 222-224, 272-274, 297-299, 370-372, 390-391, 438-440.

Extensor carpi ulnaris. — Of very remarkable size, and bicipital above; whence those who believe in the "serial" homology of the muscles of the limbs might be led to infer that it is the homologue of the *gastrocnemius*. Its two separate portions above both lie flat and superficial; the outer determines the contour of the forearm at the part, the inner is appressed in its whole extent against the flexor digitorum, from which it is separated by a slight cellular interval. The larger (*ulnar*) portion arises fleshy from the very edge of the ulna, its upper three-fourths, and still more extensively from the edge, tip, and outer face of the olecranon; it is flattened-ovate in shape, and and has an upper free edge that traverses across the notch between the inner corner of the olecranon and tip of entocondyle, where it is in relation with the "antanconæus." The smaller (*humeral*) portion takes origin from the whole length of the base of the entocondyle. These two parts only fuse just before changing into the stout tendon common to both; the ulnar portion overlaps the condylar. The tendon is longer than that of the extensor carpi radialis; it expands as usual to embrace the pisiform bone. The usual action.

Upon the back of the forearm there are three wrist *flexors* (*i. e.*, "extensors" of anthropotomy); one upon the ulnar side as usual, and only two upon the radial, instead of three (the number when the "supinator longus" is, as it should be, enumerated wtih this set). Of these two radial flexors the humeral origins and general arrangement at first favor the supposition that they are the "longior" and "brevior" of anthropotomy, and that there is no supinator longus; but the much more important indication afforded by their insertions below determines pretty conclusively, that one of them is supinator longus, and that either the other represents combined longior and brevior, or that one of these last is missing.

Supinator longus. — Here seen in its usual character as a humero-carpal, not humero-radial, muscle. Above, it occupies somewhat the position of the flexor carpi radialis brevior, being shorter than, and wholly overlaid by, the other radial flexor. It arises fleshy from the anterior aspect of the external condyle, below the origin of the following muscle, lying at first upon the humerus and head of the radius, and then upon the supinator brevis; finally, upon the back of the radius; when, becoming tendinous, it passes by the expanded foot of the radius, and is immediately inserted into the *carpus*, its radial side. It is a pure flexor carpi.

Flexor carpi radialis (longior or brevior, or more probably both?). — Rather the largest muscle of the parts, and wholly superficial, overlying both the supinators; apposed externally against extensor digitorum, and on the other side in relation with brachialis anticus and biceps. It arises fleshy from the ectocondylar ridge, from the tip up-

ward for one-third of an inch; becomes tendinous about the middle of the forearm, passes behind the foot of the radius and over the insertion of supinator longus, to spread into a broad fascial tendon, by which it is finally inserted into the bases of the 2d, 3d and 4th metacarpals. From its very high origin upon the humerus, this muscle is the principal *passive* or indirect flexor of the hand when the forearm is extended.

Flexor carpi ulnaris. — While all the other muscles lying upon the forearm, are in greater or less part condylar in origin, this arises wholly from the ulna. It is a flat muscle, lying superficial upon the ulna behind; its posterior border corresponding to the edge of the bone and arising therefrom in greatest part, but also having extensive olecranar origin. It becomes tendinous near the wrist, and is inserted into the base of the 5th metacarpal, partaking somewhat of the general tendency to aponeurotic expansion that characterizes all the tendons coming down upon the back of the hand. As somewhat of a corollary of the last statement, it may be here observed, that the tendons along the back of the wrist and hand are pressed close to the bones, while those upon the front of the wrist and the palm are away from the bones, and are separated by deep distinct interstices of areolar tissue containing much fat.

The other muscles of the forearm all act upon digits, either separately or in common.

d. Acting upon digits.

(a'. — From humerus or forearm.)

There is only one digital flexor upon the front of the forearm. The superficial or "perforatus" flexor is confined to the hand, as the corresponding flexor of the toes is to the sole. Of extensors upon the back of the forearm there are, besides the one common to the fingers, two special ones for the thumb and little finger respectively.

Flexor digitorum communis (profundus s. perforans). — Lies between the radial and ulnar extensores carpi; a muscle of large size, flattened shape, and somewhat complicated structure. It has extensive origin, both from humerus and forearm bones. Its humeral origin corresponds with that of the extensor carpi radialis, but is a little lower down upon the inner condyle and more external; this part of the muscle is larger than the other; it has aponeurotic investment upon both sides, and mainly contributes to form the stout tendon that runs someway up in its substance, and is thus, as it were, embraced by two muscular valves. The tendon flattens at the palm, in a direction contrary to the flattening of the muscle above. The ulnar portion of the muscle arises from all of the upper three-fourths of the surface of the bone—excepting a small line along the ulnar ridge which is occupied by the origin of extensor carpi ulnaris — up to the

very tip of the olecranon; it is thus longer than, but not so broad nor strong as, the humeral portion, and is wholly muscular without tendinous intersection. It joins the other portion at the common tendon below.

Between these two portions, and partly separating them, a small distinct fusiform muscular belly lies embedded. It has tolerably definite and distinct origin from the little tubercle on the base of the humerus just internal to the ulnar facet; it runs along in the substance of the digital flexor for an inch or so, and then contracts into a delicate thread-like tendon that we traced distinctly to the wrist, and there lost without making out special insertion. We found what we take for the same muscle in the opossum (*D. virginianus*); there it has precisely the same disposition and relations. It cannot be flexor digitorum superficialis, because we find the latter confined to the palm; nor flexor longus proprius pollicis, since this last must be represented in the portion of the common flexor that corresponds to the first tendon going to the thumb. We take it to be palmaris longus.

The common flexor of the fingers splits at the palm into five, not four, equal and similar tendons. Morphologically speaking, we hold "flexor longus proprius pollicis," when this exists independently, to be merely a differentiation from the common "profound" or perforating set of flexing tendons. Here the deep flexor remains intact, and there can be no dissentaneous motion of the thumb, even did the close webs permit it. The single great tendon passes the wrist flanked on either hand by the wrist extensors (radial and ulnar), filling up the depression between the two prominent carpal bones, to which the tendons of the muscles last named are attached. It fills the palm to a level, forming a thick indissoluble tendinous band, permeated with several small irregular gritty specks, like imperfect sesamoids — one for tendons of little and ring fingers, one for middle and index, with a thumb moiety lying a little to one side of the last. A little beyond the bases of the metacarpals, the tendon divides into five, as already stated. These pass each to the base of the ungual phalanx of a digit, bound down in their course, not only by the ordinary digital sheaths, but by a small stout transverse fibrous band opposite each node. Each perforates, as usual, a tendon of the superficial flexor, and has a lumbricalis, as noticed in detail below.

Extensor digitorum communis. — Arising from the outer condyle next after the origin of the flexor carpi radialis; a subfusiform, laterally flattened muscle wedged between the last named and the extensor minimi digiti, with only one border becoming superficial. With definite pointed origin from the very apex of the ectocondyle, it quickly becomes tendinous; opposite, or a little above the wrist, the tendon

grows broad, thin and flat, and expands still more upon the back of the hand. Individual tendons may of course be traced to the tips of the digits; but they are so blended in one common fascial expansion upon the back of the hand, and upon the digits are so intimately connected with the fibrous sheaths, that they require to be forcibly and somewhat arbitrarily cut apart. Extension of the digits is absolutely consentaneous, so far as this muscle is concerned.

In the muscle is formed a small, distinct, muscular belly, with a delicate abortive tendon, not traceable to definite insertion. This unquestionably represents one of the deep (special) extensors — either extensor indici or of a pollical internode; more probably the former.

Extensor minimi digiti. — Lying next to the preceding, as large as it, and perfectly distinct; in greatest part superficial, overlying the last described, and itself partly overlaid by the flexor carpi ulnaris, a short, stout, spindle-shaped muscle arising from the ectocondylar tip, and passing to the tip of the little finger. Its tendon is very distinct to the back of the hand, where it partakes of the general fascial expansiveness, and is scarcely distinguishable except by arbitrary dissection.

The constancy of this muscle is as remarkable as that of the extensor longus proprius pollicis of the foot, and is specially interesting in such a case as the present, when proper thumb muscles abort or disappear. It goes far towards substantiating the antitypy that we hold exists between the little finger and great toe.

Extensor ossis metacarpi pollicis. "*Abductor pollicis longus.*" — While the foregoing extensors are superficial, this, like the supinator brevis, is deep-seated, being entirely overlaid above. It is the only special thumb muscle — others going to the internodes being wanting. It lies upon the back of both bones of the forearm, arising fleshy from both, but mostly from the ulnar shaft, its middle third, as high up as the elbow joint and insertion of anconæus; its radial origin is only from the head and a trifle of the shaft of that bone. The muscle becomes tendinous a little below the middle of the forearm, where its obliquity increases to enable it to gain the radial side of the limb; it passes under the tendon of the flexor carpi radialis, and over that of supinator longus, across the foot of the radius, and thence runs to the base of the first metacarpal, where it is more definitely inserted than the other extensor tendons are. From its insertion and the obliquity of its tendon, it is a pure abductor, or web-spreader, rather than an extensor.

Although this muscle is inserted into the base of a metacarpal, instead of into a digital internode, it is essentially one of the digital extensor set; and as explained at greater length below, we refer to the "peroneus tertius" of anthropotomy (a muscle that, in some animals,

becomes a pure extensor of the little toe) for its posterior antitype. We hold that the digital extensors of both members are, like the flexor sets, essentially two, a deep, or "long," "perforans," and a superficial, or "short," or "perforatus." Extensor minimi digiti manus, and extensor longus hallucis pedis are differentiations from one set, and mutually antitypic; while extensor indicis, and extensors of the pollical internodes, are representatives of the other set, corresponding to the short extensor that remains upon the instep in the human subject, but which, as in the opossum, may be carried up the leg as one of the peroneal group. "Peroneus tertius" is another of the same group, corresponding with extensor ossis metacarpi pollicis. We recur to the subject again in speaking of foot muscles.

(b'. — From carpo-metacarpus.)

There are no digital muscles, except the dorsal interossei, arising from the back of the hand; on the contrary, several are found upon the palm, among them the flexor digitorum perforatus, as well as the short special thenar and hypothenar muscles, the lumbricales, and palmar interossei.

Flexor digitorum sublimis s. perforatus. — This muscle lies wholly in the palm, as the corresponding "short" flexor of the toes of man does in the sole; and, like the same muscle of, for instance, the opossum's foot, it arises upon and from the common tendon of the "long" or profound flexor digitorum. It is a small muscle, in some danger of being overlooked without due care; but its tendons may be demonstrated to have the essential characters and relations of those of a perforatus set in the customary exhibition of the latter as a muscle of the forearm. It arises as a flat fleshy mass upon the palmar (superficial) aspect of the conjoined tendon of the deep flexor, and speedily splits into fascicles that terminate in delicate tendons that pass to the bases of the fingers, and are mostly inserted into the tendons of the deep flexor a little beyond; but the tendons also spread like two "perforatus" tendons, into an expansion joining the digital sheaths, on either side of tendons of the deep flexor, which are thus embraced in the usual way.

Lumbricales. — Four of the five tendons of the deep flexor muscle are accompanied and reinforced by four accessory muscles, that arise from the dorsal (interior) aspect of the conjoined tendon before it splits, and pass to be inserted as usual into the digital sheaths at the sides of the fingers.

Thenar and hypothenar muscles. — These are nearly alike, of small size, and not dissimilar in general aspect to interossei; but their mode of insertion exposes their character. The short special flexor of the thumb is a small, flat fasciculus arising pretty definitely from the most prominent carpal bone on the radial side, lying along the

same aspect of the palm, and distinctly inserted into the front of the base of the first phalanx of the thumb. This muscle is single, and not separable into adductor, abductor, etc.; but on the hypothenar side we find what we take to be both these muscles acting upon the little finger. An *abductor* (or short flexor?) arises rather broadly from the outer side of the pisiforme, and runs along the ulnar aspect of the fifth metacarpal, to a little beyond the base of the first phalanx of the little finger, where its tendon is lost in the digital sheath. An *adductor* is smaller, a mere thread, arising from the centre of the palm, and running along the inner side of the fifth metacarpal to terminate opposite the other on the side of the little finger.

In this animal, the thumb cannot be distinguished by any function that it has from the little finger; nor by any intrinsic physical character, except its being only two- instead of three-jointed; and the special muscles of these two digits are nearly identical. In "archetypal" condition we hold these digits to be physically identical, and their subsequent differentiation in mobility, direction of axis, number of joints, and muscles acting upon them, to be purely teleological. Originally we may perhaps hold the thenar and hypothenar muscles to be modified interossei, and to be represented each by a single muscle; though as a matter of fact we ordinarily have, from two to four (most commonly three; an adductor, abductor, and flexor brevis) muscles into which each interosseus may have been differentiated. It is interesting to observe, that in this case of the *Ornithorhynchus*, with thumb and little finger so similar, as far as function is concerned, what little difference in the number, etc., of special muscles there is, is in the favor of the little finger, a condition the reverse of usual.

Interossei. — Each of the digits except the two lateral ones has a palmar interosseus; the three are quite similar. They arise almost together from the middle of the palm, and divaricate thence upon the second and fourth fingers. They lie directly upon the palmar aspect of the metacarpals and proceed to split upon the basal phalanges of the fingers, terminating on either side on the digital sheaths. The dorsal are faintly developed.

IX. Muscles connecting the Pelvis with the Body. — Only one muscle actually passes from the body to be "inserted" in the pelvis, and this, in its action at any rate, is rather a muscle of the back. The numerous other body-muscles that have pelvic attachment, are only incidentally, as it were, connected with that arch, and really belong elsewhere, as to abdomen, perinæum, etc.

Psoas parvus. — Large, much exceeding the other. It arises from vertebral centra (except the last two lumbar) up to about the eighth

and ninth dorsal from below, and by digitations from the contiguous portions of ribs, especially a few of the lower ones. Its flattened tendon, dense and glistening, extends upward upon its anterior border. It has definite insertion into the pectinæal eminence.

X. Muscles of the posterior extremity.

On reflecting the skin and panniculus, the whole limb down nearly to the heel, is seen to be enwrapped in three large, broad muscles; on the outside lie the enormous ectoglutæus and the remarkably expanded biceps; on the other side lies the great gracilis, second only to the glutæus itself in size and strength.

a. Acting upon the femur.

Perhaps the most notable peculiarity is the absence of *glutæus maximus* from this group, this muscle's insertion being carried down to the leg below. *Psoas magnus* and *iliacus* are much blended, and have remarkably extensive fleshy insertion; the same may be said of the two smaller *glutæi*. We can find no trace of *scansorius* nor *of tensor fasciæ latæ*. There are three perfectly distinct *adductores femoris* besides the *pectinæus*, making a fourth. *Pyriformis* is present; so are *quadratus femoris*, and the two *obturatores*, though the latter has no origin *within* the pelvis (being shut off by the ischio-coccygeal muscle) and does not develop *gemelli*. There is another little ischio-femoral muscle that we do not identify. Further details will be found under special heads of the muscles; but we may add here, that the femur, like the humerus, is extremely short, thick, strong, and irregular in superficies, contributing by its shape to forcible, rather than extensive, movements of the limb. It has scarcely a "neck;" its large head is embedded between two expanded trochanters of nearly equal size, projecting like ears or wings on opposite sides; below these the bone rapidly narrows to expand again into large condyles, whereof the outer is especially developed for extensive fibular connections. It is curious to find that there is no noticeable groove between the condyles in front, although there is a very large and well-formed patella; this is contrary to the general proposition, that depth of groove and size of patella are reciprocal or complementary, if, indeed, they have not a relation of cause and effect. The enormously expanded peronecranon reaches half way up the femur. The thigh is permanently abducted and rotated outward.

(a'. — From the body; "long.")

Discretion of ectoglutæus from the femoral group leaves only the following muscles to be considered in this connection: —

Psoas magnus. — Small, with distinct origin above, from the two lowest lumbar vertebræ; but inseparably blended, before passing the brim of the pelvis, with the *iliacus*. (Description resumed below.)

Pyriformis. — A thin flat triangular muscle that arises by three digitations from the fascia over the caudal vertebræ, and so, in effect, from the coccygeal spines themselves; it is wholly overlaid by the great glutæus; it lies, itself, upon lateral caudal muscles, proceeding directly transverse, narrowing as it goes, to be inserted by a thin narrow definite tendon into middle of femur behind, at foot of ectotrochanteric ridge, opposite the termination of the *glutæus minimus.* It abducts, and slightly rotates inward.

Quadratus femoris. — Below and behind the preceding, smaller, and ribbon-like. It arises from the two most prominent transverse processes of coccygeal vertebræ, in the septum betwixt the dorso-lateral and ischio-coccygeal caudal muscles, and proceeds outward and forward just behind the ectotrochanter, to be inserted into the middle of the back of the femur, opposite the insertion of the foregoing. It chiefly retroducts the thigh with slight abduction and inversion.

(b.' — From pelvic arch; "short.")

Iliacus. — With the usual position and relations; above of small size, owing to the dimensions and contour of the ilium; but below, after fusion with the *ps. magnus,* remarkable for its great fleshy mass, that fills the interval between the ilium and pectinæal eminence, and its unusually extensive and fleshy insertion into the entotrochanter. After passing the hip-joint, which it directly overlies, it lies along the inner aspect of the femur, overlaid by the pectinæus, separated from the glutæi by interposition of rectus femoris. The insertion continues along the entotrochanter and thence down the bone nearly to the inner condyle. The usual actions of flexion and eversion are here very strongly displayed.

Glutæi (*medius et minimus*). — Though somewhat blended, still mostly separable, with due care, into an anterior (*minimus*) moiety, that is partly overlapped by a posterior and more superficial division (*medius*); both are completely separated from *ectoglutæus.* They arise together from the whole surface of the narrow ilium, from apex to acetabulum; and they are inserted, fleshy, *a, mesoglutæus,* chiefly, if not wholly, into the apex of ectotrochanter, and, *b, entoglutæus,* into the same trochanter and into the ridge descending thence for one-half inch down the shaft. These muscles are flexors from their origin and line of traction, while they also invert, from their insertion.

Adductor magnus. — The muscle which we thus homologize from its posterior position and extensive femoral insertion is smaller than either of the other adductors proper, although surpassing in size the pectinæus. It arises from the ischio-pubic ramus just in advance of the origin of the semi-tendinosus, by a rather long, thin, flat tendon; forms a thin, narrow triangle, passing outward to the thigh to be inserted in a line along the postero-internal aspect of the femur from

the middle of that bone quite to the inner condyle. Above, its insertion is in relation with that of the pectinæus; below, with femoral head of gastrocnemius and insertion of the semi-tendinosus. It is almost a pure extensor, having little adductorial action, if any.

Adductor longus. — A prismatic muscle, with one surface superficial (except that it is covered by the *gracilis*), and one edge and two surfaces wedged down between *adductor magnus* and *brevis*. It arises by itself from the horizontal ramus of the pubis, a little toward the median line from the articulation of the marsupial bone, and very near the symphysis. It has definite abrupt insertion by a short tendon into the inner condyle, between the insertions of the last and the next. It is a pure adductor, and a strong one.

Adductor brevis. — A flattened fusiform muscle, lying anterior to the last, upon the *pectinæus*, which separates it from *ps. magnus* and *iliacus*. It arises from the process upon the horizontal ramus pubis at outer corner of articulation of the marsupial bone, and runs straight to a definite insertion, by a short, roundish tendon, into the inner condyle, just above the insertion of the last. A pure adductor.

Pectinæus. — A very small, flattened-oval muscle arising by a terete tendon from the deep notch at base (in front) of the remarkable pectinæal eminence, passing outward and backward upon the psoas magnus, overlaid by adductor brevis, to be inserted, by a rather long, narrow, thin, fascia-like tendon into the postero-internal ridge of the femur, near the middle of the bone. It is a *flexor*, and evertor femoris, with action not very different from that of psoas, but feeble.

Of these four adductorial muscles, it may be said briefly, that the two middle ones are adductors proper, the action of which may merge into either flexion or extension, in extreme postures of the thigh; that the first described is always extensor and barely adductor, while the last is always flexor and barely adductor.

It will be observed that the usual essential arrangement of four adductorial planes is preserved, the hind extremity offering no such deviation in this respect as the fore does in its division of coraco-brachialis into two, and their high development; a circumstance highly favoring the reference of the four adductors to coraco-brachialis and pectoralis major, that has been made by Wilder.* The question whether the adductors are, or the pectinæus is, to be referred to pectoralis, and conversely, probably finally hinges upon determination of pubis as = coracoid, or as = clavicle. The present indication, from the extensive development of two coraco-brachiales, is, that these are represented in the hind limb by the adductors proper, leaving pectinæus as the correlative of the pectoralis.

* Op. cit. p. 32.

Three ischio-femoral muscles remain to be described; their determination may be attended with difficulty. One (*a*, see below) is pretty obviously *obturator externus;* another (*b*) appears like a partial segregation from *a;* the third (*c*) should represent *obturator internus*, although it is cut off from the inner surface of the ischium, has no radiation of tendon, and is unaccompanied by gemelli. All three proceed to the back part of the femur, at the expanded intertrochanteric surface, instead of conniving at a "digital fossa."

a. — With broad rounded origin from the whole outer surface of the ischium and obturator membrane, narrowing as it passes straight outward and forward across the back of the hip-joint to definite insertion (see above) between the insertions of *b* and *c*.

b. — Like a part of the preceding, and somewhat blended therewith, but mainly distinct. It arises fleshy from the base of the ischio-pubic ramus along and below the articulation of the marsupial bones, and from the upper margin of the obturator foramen; passes back of the hip-joint and entotrochanter to a broad, fleshy insertion into most of the expanded intertrochanteric space. This and *a* extend and evert the femur.

c. — Arises fleshy from the whole of the thickened concave posterior border of the ischio-iliac ramus, from tuber ischii to acetabulum; passes outward and forward across the back of the hip-joint to the ectotrochanter, where it is inserted fleshy into the border and back surface of that process just below its apex. Its action is similar to those of the two preceding.

In examining the operations of the muscles that collectively act upon the femur, there is probably not much to note, after we have seen the permanent abduction and eversion of the thigh. The general preponderance of extensors over flexors, etc., is in relation to the force of the backward stroke in swimming. The more interesting features of the hind limb are shown mainly from the knee downward.

b. Acting upon the leg.

The most remarkable thing about the crural muscles is the presence of the *intertibialis* (a feature unique in mammalian myology?). Probably the next most so, is the entrance of the enormous *ecto-glutæus* into the crural instead of the femoral group, its low insertion at the foot, and its connection there with a *caudo-tibial extensor*. Although the latter muscle occurs among marsupials, here we have it under special conditions. The *gracilis* is second only to the great glutæus in bulk, and sends a peculiar slip backward to the cloaca. The *biceps* is large and though rather unusually thin and fan-shaped, is exhibited in the normal condition of that muscle; that is, with only one (an ischial) head, and no femoral attachment — its bicipital dis-

position, with a femoral head, being an accident of higher mammals. The *rectus*, as usual among lower beasts, is discrete from the *vasti;* these are blended together, with no evident *cruræus*. The *sartorius* is a flexor cruris, and, therefore, not in its normal office; but it is interesting to note, that its origin is relegated to the pelvis, and placed lower down than in some animals, as marsupials, above this monotreme; whereas, a higher, even a vertebral origin would have been anticipated, in view of the animal's ornithic tendency. The motions of the leg at the knee-joint, and actions of the muscles, will be noted after the special descriptions.

(a′. — From the body; "long.")

We cannot demonstrate any satisfactory distinction between the ectoglutæus and the "flexor accessorius à caudâ ad tibiam tendens," nor between this last and the "intertibialis." With howmuchsoever difference in their origin, course, and function, the three blend in some or another part of their extent. They form collectively an enormous flexor cruris, effecting a powerful backward pull (extension) of the whole limb. Ectoglutæus is also an outward rotator and abductor of the limb; the caudal muscle a direct retroductor (and flexor cruris), while the slip passing from one tibia to the other, is an adductor drawing the heels together under the tail, besides being a flexor cruris. The details of this singular arrangement, which probably, from its advantageous traction, acts more powerfully, for its size, than any other muscular apparatus of the limbs of mammals, are these:—

Ectoglutæus arises along the median line over the back of the sacrum and several anterior coccygeal vertebræ, in apposition with its fellow, in a straight line from the apex of the ilium downward to a point on the tail opposite the origin of the panniculus. Except in being overlaid by the last named, it is wholly superficial, resting above upon the other two glutæi, the pyriformis, and the dorso-lateral caudal extensor; farther down, lying upon the last mentioned, and part of the biceps, from the origin of which, however, it is separated by the width of the tail at the part. The upper fibres run very obliquely backward; the others have successively more and more transverse direction, and finally the lowermost run outward and a little forward. At the posterior extremity of origin occurs an interval, equal to the distance between the spinous and the transverse processes of the coccygeal vertebræ; then a stout bundle of fibres — the *flexor accessorius* — takes fleshy origin from the tip of the transverse processes of two or three vertebræ, and soon blends with glutæus proper. From the anterior border of flexor accessorius, *intertibialis* becomes differentiated about an inch from the leg, and passes directly transverse across the tail below, rather more than an inch in front of the anus, to be continuous with its fellow of the other side; it is attached to the pannic-

ulus where it crosses the median line. The insertion of this extensive apparatus is rather diffuse, and may not always be exactly as we made it out in this specimen. Glutæus proper becomes tendinous, or rather fascial, dips among the tendons of the back of the leg just above the heel, and thus has indefinite insertion, but is mainly prolonged over base of the spur, and heel, to be continuous with plantar fascia. The caudal part, on the other hand, has definite insertion into the tibia; twisting for that purpose, much as latissimus or pectoralis major does, so that the most anterior fibres (those that give off the intertibialis) are inserted lowest down. The insertion is in the middle third of the tibia behind, for about half an inch, opposite the insertion of the gracilis. The plantar attachments doubtless cause the muscle to act somewhat as an extensor of the foot — in obvious subserviency to advantageous action in giving the back-stroke.

(b′. — From the pelvic arch: "long.")

Biceps. — The external or fibular flexor cruris is a single-headed broadly triangular muscle, without femoral origin. It arises definitely from the tuber ischii, at first overlaid by the ectoglutæus; as it emerges from under which, it rapidly widens into a broad and comparatively thin plane that spreads over nearly all the leg, in apposition, at first with the tibial flexores cruris that also arise from the ischiatic tuberosity, and afterwards with the great fibular head of the gastrocnemius and other peroneal muscles. Partly in consequence, very likely, of the burial of the fibula in muscle, the biceps has no actual insertion into that bone, except just at the upper margin of the spatulate peronecranon. Muscular fibres terminate, in a curved line corresponding to the outer border of the calf of the leg, in a broad dense aponeurosis that sweeps over and envelops the whole front of the leg, with final definite insertion into the crest of the *tibia* from the patella two-thirds way down the leg, besides sending below sundry fascial prolongations between the tendons of anterior tibial muscles. This actual insertion of the *outer* (fibular) flexor cruris into the *inner* bone of the leg occurs in marsupials also, as, for instance, in the *Didelphys virginiana*, where it offers a highly interesting analogy to the *ulnar* insertion of one foot of the biceps brachii of the same animal. The actions of the *Ornithorhynchus*' biceps cruris are several; firstly, it retroducts the femur and extends the whole limb; secondly, it is a flexor of the leg; and thirdly, it is a powerful external rotator of the limb below the knee, turning the heel directly towards, and the claws away from, the body. The mechanism of the knee-joint, as explained below, allows this action, which is furthered by the way the aponeurotic tendon of insertion of the biceps laps over the swelling muscles of the calf, as a band over a pulley.

Gracilis. — Of great size. Arises fleshy, in apposition with its fellow for the whole length of the symphysis pubis, and greater part of outer surface of marsupial bone. Above, it is connected with the symphyseal aponeurosis of the obliquus externus abdominis; below, with a slight tendinous intersection, it sends straight backward the peculiar slip that goes to the cloaca. The muscle passes nearly transversely outwards, overlying all the other tibial flexors as well as the femoral adductors. Its posterior border is curved and somewhat tucked under, while the anterior border is straight; the muscle converges and grows at the same time thinner, to be inserted by a short, flat, broad tendon into the shaft of the tibia, for half an inch along the middle third of the bone. Primarily, the gracilis is a strong direct adductor of the whole limb; next it flexes the tibia, and finally rotates the leg inward.

Semitendinosus and *Semimembranosus* have continuous origins and insertions, parallel and contiguous courses, and similar functions: neither displays the physical structure that led some one to encumber anatomy with two of the most unhandy and inept names in the science. Both are direct flexors of the leg, and extensors of the whole limb, with a little inwardly rotating action. The *one-half membranosus* is the posterior of the two; it has definite origin from the tip of the ischium next to the biceps; is of a flattened terete shape, taking straight course to the leg, where it has extensive fleshy insertion for half an inch along the upper third of the tibia, just to one side of its crest. The *one-half tendinosus*, has more extensive and chiefly tendinous, but also partly fleshy origin from the ascending ramus of the ischium, between the origin of the foregoing and that of the adductor. It forms a prismatic muscle, owing to its flat under and superficial, and bevelled posterior, aspects; the one-half membranosus resting on the latter. It converges abruptly to a point, with definite tendinous insertion into the head of the tibia, at the most internal and projecting point of the latter.

Sartorius.— Here its true office as an extensor cruris and flexor femoris is contravened, and we find the muscle, much as in man, at once a flexor of two consecutive segments. Its low, instead of high, pelvic, or even vertebral, origin has been already mentioned. It arises from the apex of the pectinæal eminence, in connection with the insertion of the psoas parvus, by a round cord-like tendon; passes outward upon the inner aspect of the limb, overlying pectinæus and adductors, expanding remarkably as it goes, into a flattened, triangular muscle. Narrowing somewhat, it becomes aponeurotic just below the internal condyle of the femur, and is attached to the naked space in front of the tibia above, though really continuous with the somewhat similar fascial expansion of the biceps. It is, firstly, an adduc-

tor of the whole limb; secondly, a flexor femoris; thirdly, a flexor cruris; and finally, it rotates the leg a little inward.

Rectus femoris. — Entirely distinct from the rest of the "triceps extensor cruris," which, as a whole, is not very highly developed. Rectus has definite origin by a stout, flattened tendon from the bottom of the iliac shaft, just above and in front of the acetabulum. The tendon radiates upon the surface of the muscle, and helps to keep it discrete from vasti. The muscle enlarges below, forming a pyramidal belly that passes between and separates iliacus and glutæus minimus. Farther on, it partly separates in two; a superficial portion, the larger, has virtual insertion into the patella; the deep portion, smaller and thinner, runs down fleshy over the face of this sesamoid, to be inserted with the ligamentum patellæ into the head of the tibia by a fascial expansion. A pure extensor cruris.

Vasti. — There is no "cruræus," although with the exercise of the ingenuity that anthropotomy has developed, such might perhaps be invented. The two vasti form a single fleshy mass of moderate size, arising from the whole of the broad anterior femoral surface, from the insertion of psoas and iliacus on one side to that of glutæi on the other. The insertion is fleshy, into the patella, its whole width. The great size of this bone, and its remarkably distinct ligament for tibial attachment, give it less appearance of a sesamoid than usual. The vasti are pure extensors.

Both crural bones articulate extensively with the femur; and the conformation of the knee-joint in other respects, is such, that the leg enjoys rotatory movements equivalent to pronation and supination, and more closely resembling those of the elbow than is usual in the mammalian series. The oar that the foot makes, like that of the hand, is feathered at the joint above. Examination of above described actions of muscles moving the leg will show how this is accomplished; while certain motions at the ankle, to be readily appreciated from the notice of the leg muscles that here follows, further the design of bringing the limb forward with the edge of the web cutting the water, and carrying it backward with directly opposed broad plantar surface.

Poplitæus. — The proper rotator of the leg is of large size, and, as usual, deep-seated at the back of the knee-joint and leg. It arises fleshy from the inner corner of the crest of the fibula for a third of an inch; passes obliquely across the joint, and downwards, to the tibia, gaining some fibres of origin from the articular head of the fibula as it passes that point; but we made out no femoral attachment. It is inserted fleshy into the broad flat space on the back of the tibia, just below its head.

If this muscle really is poplitæus, here we have it without femoral

relations, and more nearly resembling in its attachments, course and function, the "interosseus cruris" of some animals, which is not developed in the present instance.

This muscle is decidedly not to be referred to the pronator radii teres.

c. Acting upon tarso-metatarsus — from femur or leg, or both.

The great size of the spoon-shaped peronecranon, from which nearly all the muscles of the foot arise, either wholly or in part, effects (*a*) greater power of such muscles, in consequence of actual increase of contractile mass, (*b*) advantageous rotatory operation, and (*c*) a very peculiarly shaped calf. On the front and outer side of the leg, the muscles rather suddenly contract to tendons at about the middle; those behind run nearly to the heel; all are very closely packed above, while below, the tendons are much separated by intervention of fascial and adipose tissue.

We may note, at the outset, that "peroneus tertius" occurs here in its true character of extensor minimi digiti pedis — a common, if not the customary condition of the muscle in animals below the highest; our notion of its antitypic relations with a muscle of the fore limb is given further on. The digital extensor set is double in the leg; *i. e.*, the deep set, that in man, etc., is restricted to the instep, here runs up the leg. In some marsupials, *e.g.*, opossum, the same muscle is peroneal, and deflects behind the malleolus externus before distributing its tendons to the digits. Here it comes directly down the front of the leg and is clearly displayed as one of the true digital extensors, corresponding to the special extensores pollicis and indicis, in the hand. Extensor longus hallucis is present and of usual characters.

Flexor tarsi tibialis; h. e., Tibialis anticus.—The innermost muscle upon the front of the leg; large; superficial; arising by two heads. The smaller of these takes fleshy origin from the tibial shaft in front, from its head half way down; and is divided by a cellular interspace from the other, the larger, head which arises from the patella and a corner of the peronecranon in apposition with the extensor hallucis. The two join and become tendinous at the middle of the leg; the stout tendon passes in front of the inner malleolus, most internal of any, to its customary insertion into the base of the first metatarsal. The usual action.

Extensor tarsi tibialis; h. e., Tibialis posticus. — A large, very deep-seated muscle upon the back of the leg, filling the wide interrosseus space, but having no tibial origin. It consists essentially of two parts; the shorter and thicker of these arises from the articular head of the fibula, and a ridge thence two-thirds way down the tibial aspect of that bone; the longer and thinner part from the back of the shaft of the fibula and most of the posterior surface of the perone-

cranon. It is overlaid by the plantaris, has the flexor longus digitorum to the outside, and the poplitæus to the inside. Its tendon passes behind the inner malleolus to be inserted at the most prominent point of the inner aspect of the tarsus.

Plantaris. — A muscle of great size, comparatively. It arises fleshy from the posterior surface of the peronecranon, and its crest, between poplitæus and tibialis posticus, and lies in a sort of bed formed by the last named. It continues fleshy two-thirds way down the leg; then its stout tendon, instead of passing with tendo Achillis to the os calcis, glides behind the inner malleolus, and expands into a strong plantar fascia.

Gastrocnemius. — Of rather remarkable conformation; its two heads are widely separated, and very different in shape; one is much larger than the other. The larger arises fleshy from the outer one-half or two-thirds of the fibular crest, and immediately forms an immense bulging mass that rivals, proportionally, the human calf itself; this lies upon the outer side and back of the leg, mostly upon the fibular flexor of the toes. It forms a stout tendo Achillis at the lower third of the leg, with the usual calcaneal insertion. The tendon has aponeurotic expansion upon the outer surface of the muscle. The smaller head arises fleshy from the inner femoral condyle, at its back, just above the capsular ligament of the knee-joint. It is thick at first, but soon becomes flattened into a ribbon-like muscle that passes very obliquely outward down the leg, to join the outer gastrocnemius at the middle of the leg with a sort of tendinous intersection — one side being as it were partly laid over the outer gastrocnemius, the other directly continuous. This construction, though in evident relation to rotatory powers of the leg, is barely a foreshadowing of that complete separation of the two gastrocnemii, and presence of two tendones Achillis, that obtains in some marsupials.

Peroneus longus. — A large superficial muscle upon the antero-external aspect of the leg, lying upon "peroneus tertius" and extensor longus digitorum, in relation internally with extensor hallucis. It arises fleshy from the outer moiety of crest and adjoining anterior surface of the fibula; forms a thick spindle-shaped belly, and becomes tendinous just below the middle of the leg. Its tendon proceeds along the outer aspect of the outer malleolus, a little in front of it, if anything, rather than behind it, gains the side of the ankle in front, and dips below the base of the 5th metatarsal. It then, as usual, traverses a groove obliquely across the sole, along the conjoined heads of the metatarsals, to be inserted into the base of the 1st.

Extensor hallucis. — The next muscle to the *tibialis anticus;* a long, roundish, but somewhat compressed belly arising from a tubercle on the outer aspect of the tibial head, and from contiguous portions of the peronecranon. Its tendon, which forms about the middle of the

leg, passes at first obliquely across the middle of the instep, and thence more laterally to gain the great toe, upon the surface of which it runs to the base of the ungual phalanx. It is a large muscle, wholly superficial, and, like the tibialis anticus, is partly separable into tibial and fibular heads of origin.

Extensor "longus!" digitorum. — Smaller than either of the muscles upon the direct front of the leg, with a short belly and a long tendon; it is deep-seated, covered over by the preceding, and in apposition with the peroneal muscles proper. Its origin is wholly fibular, by a short, stout tendon, from a tubercle on the articular head of the fibula, and it lies wholly upon this bone. Its long slender tendon passes a little obliquely down upon the fibula, then along the groove between the bone and the tibia, just internal to the tendon of the next described muscle. On the instep it spreads into a fan-shaped fascial expansion that covers most of the dorsum, and is then differentiated into 4 tendons that supply, in the usual way, all the digits except the great toe.

Extensor "brevis!" digitorum. — This is the muscle that in man occupies the instep; here carried up the leg; not, however, as in opossum, etc., to form a peroneal muscle passing behind the outer malleolus, but coming obliquely down the leg in front, crossing the fibula below, gaining the groove between this bone and the tibia, alongside the tendon of the foregoing. The muscular part is the most deep-seated of any on the front of the leg, and the smallest of all; a thin little plane arising from, and lying upon the expanded surface of the fibula opposite and a little above the articular head of this bone. The tendon that it soon forms is *flat*, and, with the course just mentioned, spreads, after passing the ankle, into a large fan-shaped plane, similar to, and lying underneath the plane of extensor longus. It is difficult of being distinguished into tendons, but with some care may be demonstrated to proceed to all five digits, and nearly or quite to their tips. In its digital course, it is closely connected with the sheath of the toes, and it runs rather along their sides than directly upon their dorsal aspects.

Extensor minimi digiti. Peroneus tertius. — The third peroneal or flexor tarsi fibularis of anthropotomy is a muscle of considerable size, that lies upon the extensor "brevis" digitorum, on the front of the fibula, and is overlaid by the p. longus. It is a flattened strip that arises fleshy from the crest of the fibula and contiguous anterior surface, narrowing regularly as it descends, and becoming tendinous a little below the middle of the leg. Crossing the tendon of p. longus, its tendon gains the outer border of the foot, at base of the 5th metatarsal, and thence runs along the little toe to be inserted into the base of its ungual phalanx. It is an abducting extensor of that digit.

This muscle, which, in man, is inconsiderable and appears like an off-

set of the common long extensor of the digits arrested at the base of the fifth metatarsal, here appears in what we hold for its true character. It has the same disposition and relations in some marsupials. We consider it the antitype of the extensor ossis metacarpi pollicis. At first sight, especially in view of its running to the extremity of the little toe, one might think it rather referable, if to any of the thumb muscles, to one or both of the extensors of the pollical internodes, when these are present, as in man. But these last appear to be decidedly dismemberments of a common deep extensor set, of which the special extensor indicis is another; and these are already amply accounted for by the extensor brevis digitorum pedis.

Flexor digitorum longus (*fibularis*). — There is no tibial flexor of the toes; the fibular flexor gives off part of the large tendons that go to terminal phalanges, the others being supplied by a muscle of the sole, that occupies the situation of the human "flexor accessorius." The flexor is a very large muscle that arises fleshy from the outer aspect of the shaft of the fibula, its upper half, and thence up along the back surface of the ridge that runs up the crest; and from the outer corner of the crest itself; it is partially contained betwixt the gastrocnemius externus and the peroneus longus. At the lower third of the leg, it develops a stout tendon that runs some way upon its outer surface, giving a dense glistening aponeurotic investment. The tendon passes behind the middle of the heel, in a deep groove alongside the calcaneum, where it becomes flattened, and soon splits into only *three* tendons. Two of these, that appear to be the most direct continuations of the original tendon, run to the ungual phalanges of the first and second toes; the third divaricates more, and passes between the two heads of the flexor brevis minimi digiti to its insertion into the base of the ungual phalanx of the little toe. Thus the 3d and 4th toes are so far unsupplied with large tendons, from this muscle.

Flexor sublimis (*brevis*) *digitorum pedis.* — We should judge from its appearance in the specimen that it might be larger, and even supply more digits, than we found to be the case in this instance. It forms a short, flat, fleshy belly, lying upon, and arising wholly from, the flattened tendon of the foregoing, with no osseous origin. It divides below into *two* tendons only, that are lost in the digital sheaths of the 2d and 3d toes near their bases.

This appears to be the antitype of the muscle of the same name in the hand. The muscle has a similar disposition, and arises in the same way from the tendon of the main flexor, in the opossum, although in this animal it is carried half way up the leg.

Thus far, we have seen no tendon going to the 4th digit. This is supplied by a little muscle of the sole that lies in the position of flexor accessorius of anthropotomy, though decidedly not to be morphologically identified therewith. We hold it on the contrary to be

really a dismemberment of the long common fibular flexor, restrained to the foot, just as the muscle that sends the single tendon to the opossum's great toe is. Ordinarily, perhaps, in unguiculate mammals at least, there are *two* long deep digital flexors, one tibial, the other fibular, the distribution of the individual tendons of which is variable. Thus in man, one goes to the great toe alone, the other to all the rest of the digits; and the two seem to have, as it were, exchanged places, since their tendons cross to reach their respective destinations. In the next animal, viz., the gorilla, it is the *other* muscle that gives off the most tendons. In the opossum, for example, the flexor hallucis occurs, and is on its proper, viz., tibial, side of the leg; but its tendon aborts at the heel, being there fastened to the common tendon; and its place is supplied by a little plantar calcaneal muscle that crosses the foot obliquely and gives off a tendon as large as any from the common flexor; this tendon runs between the heads of the flexor brevis hallucis, and is inserted in the usual manner into the base of the distal phalanx of the great toe. Now in the *Ornithorhynchus* with only one long deep flexor digitorum, we have a similar arrangement, though with a little variation. The plantar dismemberment of the common long deep flexor digitorum forms a short, fleshy belly that arises from the side of the os calcis, and soon becomes tendinous, dividing into *two* tendons that pass to terminal phalanges of the 3d and 4th digits. These tendons are fully as large as those coming down from the leg, and have identical disposition upon the digits.

All that has just been said has reference only to the subdivisions of *one*—the long deep—set of digital flexors; that is, it is without bringing into the discussion the above described flexor "brevis" or *sublimis*. The latter corresponds to the muscle of the same name in the hand. The former (flexor longus digitorum) is so variously differentiated into two muscles and several tendons in the mammalian series, that it is safest, as well as most philosophical, to regard it as a morphological integer, susceptible of varying dismemberments, which, as a matter of fact, supply different digits in different animals. The corresponding muscle of the hand is probably in most unguiculates single, with *five* identical tendons; when, as in man, it is differentiated into two, one of these is flexor longus pollicis, the other flexor digitorum profundus. In the foot, the muscle is probably usually divided into two that have, with different animals, different digital distribution, as just stated. It will be found best to distinguish these two simply as respectively 'fibular,' and 'tibial,' without reference to the particular digits that either supplies.*

*In drawing antitypes of the deep digital flexors of *man*, it must be remembered, that, as above mentioned, the human flexores *tibialis* and *fibularis* have, as it were, changed places, so that flexor hallucis is the correlative of the flexor digitorum profundus, and flexor longus digitorum pedis of the flexor proprius pollicis.

(b.' — From tarso-metatarse.)

Although the little calcaneal muscle, just discussed, really lies wholly on the sole, yet it belongs to the last group, and we only now come to muscles of the digits that may be properly called tarso-metatarsal. As usual, these are more numerous and bulky upon the plantar than upon the dorsal aspect of the foot. They are chiefly the special muscles of the great and little toes. We find but one for the hallux, while on the other hand, three may be demonstrated upon the little toe. In this animal, there is absolutely no specialization of external form, etc., of the thumb and great toe; while these digits are, if anything, less favored with special muscles than either the little finger or little toe is. Here, at any rate, nothing but the difference in the number of the internodes stands in the way of the correlation of the little toe with the thumb, and conversely, of the great toe with the little finger.

Flexor brevis hallucis. — A very small and insignificant muscle lying upon the first metatarsal; it arises near the base of this bone, and is inserted by two heads into either side of the base of the great toe, with a pair of sesamoids. We can distinguish no other muscle upon the ball of the great toe. It directly flexes.

Flexor brevis minimi digiti. — A short, plump muscle, almost entirely fleshy, that arises from the os calcis, passes down over the next muscle, divides into two heads, between which runs a tendon of the long fibular flexor digitorum; they are inserted into either side of the base of the little toe.

Abductor minimi digiti. — A flattish, fleshy muscle, lying along the outer border of the foot, filling up what would otherwise be a depression between the os calcis and the head of the 5th metatarsal, arising from the former, and inserted into the outer aspect of the basal phalanx of the little toe.

Adductor minimi digiti. — A well developed, distinct, long, flat strip of muscle arising near the head of the 3d metatarsal at the centre of the sole, and passing obliquely outward and forward to be inserted into the inner side of the base of the 1st phalanx of the little toe.

This muscle seems to be the largest and outermost of a series of four that diminish successively from the 5th to the 2d toe. They arise near together, along a line corresponding to the passage of the tendon of the peroneus longus across the sole; and each is inserted into the inner side of the base of a digit. They are apparently spreaders of the web, like the interrossei from which, however, they are wholly distinct.

The *plantar interossei* lie wholly upon, instead of between, the metatarsals, and are well developed. They embrace the bases of the 2d - 4th digits. The dorsal were not specially examined; they appeared to be inconsiderable.

It is only just to ourselves to say, in concluding a necessarily im-

perfect article, that the circumstances under which it was prepared deprived us of the advantage of consulting Meckel's memoir, or anything else that may have been published upon the subject, except the short notice in *Owen's* C. A. & P. V., iii, pp. 2–7. This frank statement of our limited resources, so far from being made with any desire of disarming criticism, is intended to invite correction of errors we may have committed in identification of muscles; and this, we trust, a certain accuracy of descriptive detail will render comparatively easy.

We desire to record here our present conviction, that the identification, with entire accuracy, of the singularly modified muscles that lie upon the sauropsidan shoulder-girdle of this mammal, will go far toward establishing, in myology, the hypothesis of Antero-posterior Symmetry that is maintained by Wyman, Wilder, and the writer.

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